Putting Self on the Map:
an examination of user-driven mapping

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Russell Kirkpatrick

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with 2 separate diskettes
in back pocket.

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Abstract

This thesis advances the basic argument that many people have difficulty interpreting cartographic information because that information has not been provided to meet their needs. Map users are wrongly regarded as passive users of a finished product. Original work in this thesis attempts to make the wishes of map users more prominent in the mapmaking process.

The research is based upon the presupposition that people conduct communicative activity as a ritual, the form of which is designed to advantage some participants while imposing on others. Cartographic communication is examined on this basis and the map, as a form of ritualised communication, is deconstructed to yield insight into the participants in the mapping process. This deconstruction takes the form of a critical review of historical and contemporary cartography.

The discussion of cartographic communication leads to a number of important advances in cartographic theory. The author presents a model of the mechanics of cartographic communication, and discusses the evocation and recovery of meaning from maps with reference to a recently-developed psycholinguistic theory of communication.

The significant contribution of this thesis is found in the examination of alternative map subject matter and form. A map form incorporating elements of time as well as space is argued to be of more relevance to many map users. Results from a number of tests demonstrate that this alternative map form is well suited to the representation of personal data. The user-driven generation of cartographic subject matter is tested by the construction and operation of a Geographic Information System (G.I.S.) into which users can contribute data. Recorded use of this system, named Tourist Info, demonstrates that groups of users who are often disadvantaged in the provision of traditional cartography find Tourist Info helpful.

This thesis concludes that it is both theoretically and practically possible to provide map users with the opportunity to determine the form and subject matter of maps relevant to their needs.

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Pastor Murray Watkinson was supernaturally insightful and supportive, and the Celebration Centre fellowship loving and understanding.

Dorinda. More than a wife, more of a miracle. How many times did we say "I'll be glad when this thesis is over"? Well, now it is. Let's catch up on all we've missed out.

I have two boys, Iain and Alex. Neither of them have known their father to be doing anything other than "Daddy in the office working, Apple computer." Now maybe Daddy will have some time in the evenings for them.

Thank you, Jesus, for everything. What's next?

Dedication

To Dorinda, Iain and Alex, my family.

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Chapter One

Introduction

Thesis Goals

This thesis advances the argument that many people have difficulty using maps because their needs are marginalised in the mapping process. Following from this, the discussion explores ways of making people's spatial needs and experiences central in the design of map form and the selection of map content.

The central argument of this thesis is introduced by considering the views of two writers, R.C. Kingsbury and Rex Walford. Kingsbury holds the position that maps should be designed to focus the mind rather than to stimulate the imagination:

> "The border helps 'wrap up the package' and acts as a wall to keep the user's eyes focused on the map presentation rather than wandering away into the white margins beyond the map proper" (Kingsbury, 1969: 24).

According to this precept the map maker has something specific to say (the map proper) and the map border makes the user focus on what is being said. Maps inform the user of facts he or she would otherwise not have known.

In contrast, Walford identifies the awakening of his geographical curiosity with the experience of seeing a different type of map. It is a map primarily designed not to inform but to invite the viewer to look beyond its borders. This map is the frontispiece to The Wind in the Willows (Figure 1.1). Walford says of this map: "to me, at the age of four, it was just a graphic evocation of place and a fantasy full of reality" (Walford, 1985: 16). It led him to ask, with Mole, "What is beyond the Wild Wood again?" (Grahame, 1938: 13).

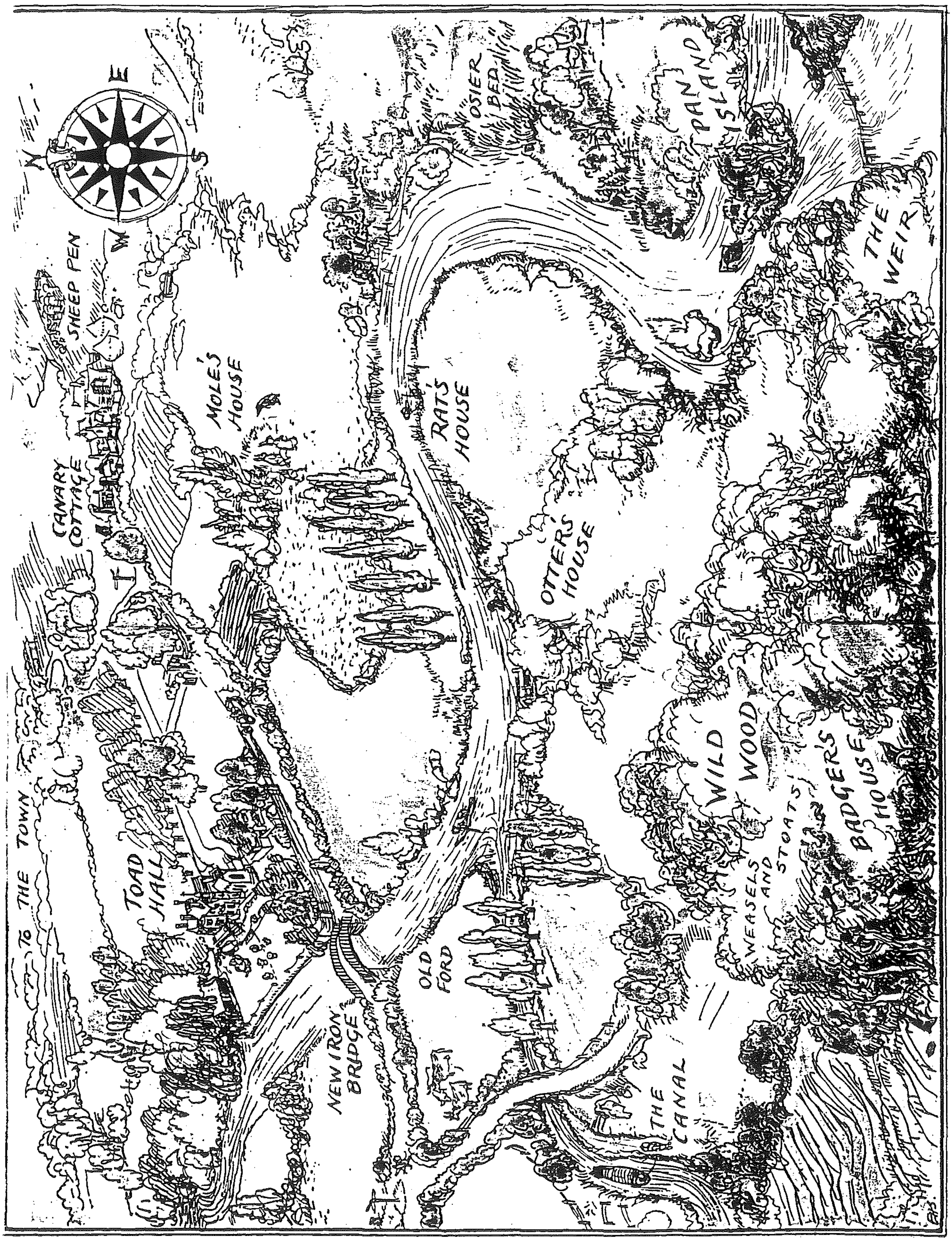


Figure 1.1. Frontispiece to The Wind in the Willows. Source: Grahame, 1938.

Walford's experience with this map contributed to his attitude towards geography. In reviewing his reasons for teaching geography, he says

> "Most of us are geographers and geography teachers because of the nurturing of... curiosity about our surroundings....our essential role in schools, both primary and secondary, and in colleges too, is to at least stimulate and inform that curiosity in those whom we teach" (1985: 13).

This boundless curiosity contrasts with Kingsbury's utilitarian and restrictive view of the function of maps, a view that maps are designed to satisfy rather than stimulate intellectual hunger. Obviously not all educators agree on the role of maps in education or the effects of maps (and the way they are taught) on children. As one cartographer writes:

> "... millions of children are exposed to hundreds of maps in their social studies textbooks each year. Would it matter to our culture if there were no maps in these books? Or should there be even more maps than there are? The fact is, we haven't the faintest notion what the answers to such questions (or others like them) might be" (Petchenik, 1985: 12).

Yet educational authorities apparently regard map interpretation as an essential skill. The report of the Assessment for Better Learning in Education (ABLE) working party in New Zealand suggested an assessment of fourteen-year-olds annually "on important basic skills." Among the skills it is suggested to test are "filling in tax forms, reading home appliance instructions, interpreting maps, and extracting information from graphs and tables" (The Press, August 10, 1990).

For many the use of a map is not an enjoyable experience. Chris Board quotes an advertisement by the Brewers Society which says, in part, "I don't believe in maps because it never looks like it says on the maps when you get there." (Board, 1967: 671). "How do people feel about maps?... Only 14% of the people in the United States claim to like maps. Even people who claim to like maps use them only as a last choice. Maps are a hassle" says Barry Karlin of an electronic drivers' guide (Sylvester, 1987: 17).

The few studies to have been conducted on the use of maps in society reveal large sections of the population for whom maps appear to have little value. For example, a 1975 study of the map market in Great Britain revealed that only 34% of map users were women, 39% of all households did not own any maps at all and less than half the population had referred to a map of any type during the previous year (Drewitt, 1975). A legitimate goal of cartographic research is to ask why, for many people, the experience of using a map is neither a successful nor a stimulating one.

My own map experiences have certainly been stimulating. As a child, my 'action-space' was severely limited compared to other children I knew (Figure 1.2). Having an active imagination and a limited space to explore led to the vicarious exploration of places I could not reach through travelogues, encyclopedias and atlases.

I 'borrowed' copies of an old atlas from school to look at. The maps made great jigsaws when cut up along national boundaries. The back yard of our home became a small model world of the countries I learned about through my reading (Figure 1.3). I remember the yard with great clarity and fondness. It was a combination of long grass and longer grass, with old outbuildings, a sand pit and plenty of places to hide in. I superimposed my own imaginary landscape on the already interesting landscape of the back yard.

I was not really concerned with scale, distance or direction. No cartographic conventions constrained my imagination. So what if North and South America were separated by Africa and the Ocean? What mattered to me was not where they were, but simply that they were there.

When I did travel further afield it was a great adventure. My grandparents lived in a town about 320 kilometres south of our home. On one occasion I was allowed to travel by myself on the train to see them. In the weeks beforehand I got hold of a Railways map of the journey and, combining this with information from the Automobile Association handbook, produced a set of cards which had information about all the places (towns, rivers, tunnels and the like) that the train would pass through. I do remember feeling a little embarrassed at the reactions of others on the train as I went through these cards. On reflection, I probably would have been wiser not to have shouted "This is the Mihiwaka Tunnel, and it is 1780 yards long!"

The cards added to what I could see from the train. Travelling by train was like travelling in a long (but picturesque) tube, the sides of which were determined by the horizons to the left and right. I found it exciting when, one by one, the places rolled past my window in precisely the order I had arranged them. Even better, my cards told me about what was beyond the horizon. They facilitated the delicious pleasures of both entering the map and of extending its borders.

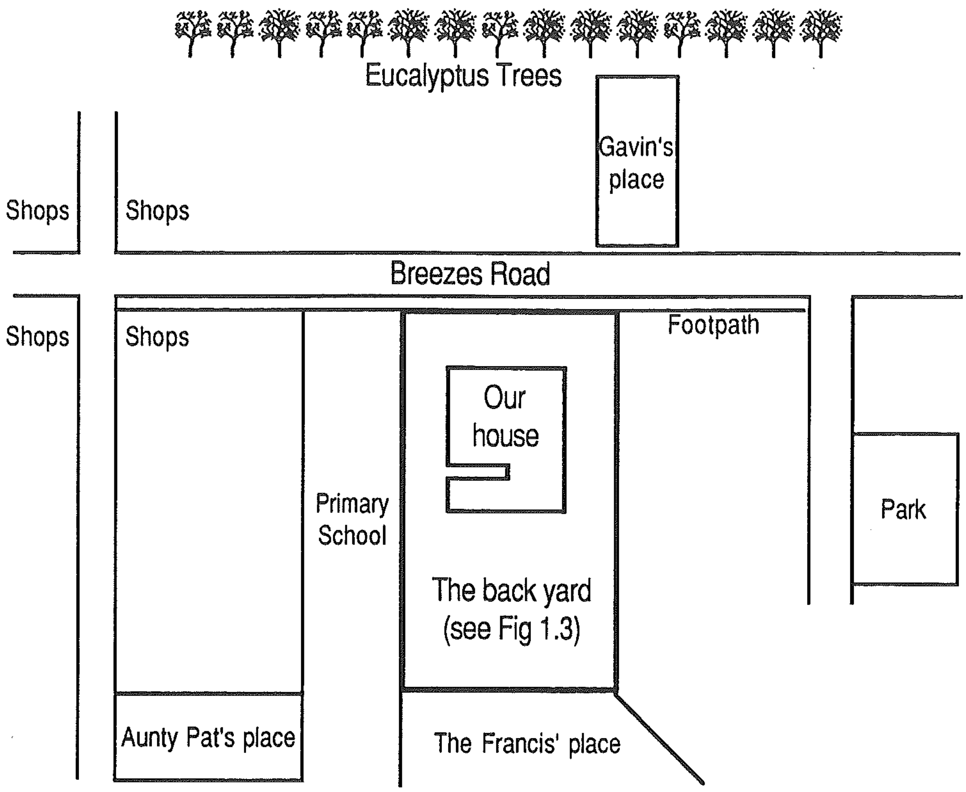


Figure 1.2. The author's action space as an eight year old (not to scale).

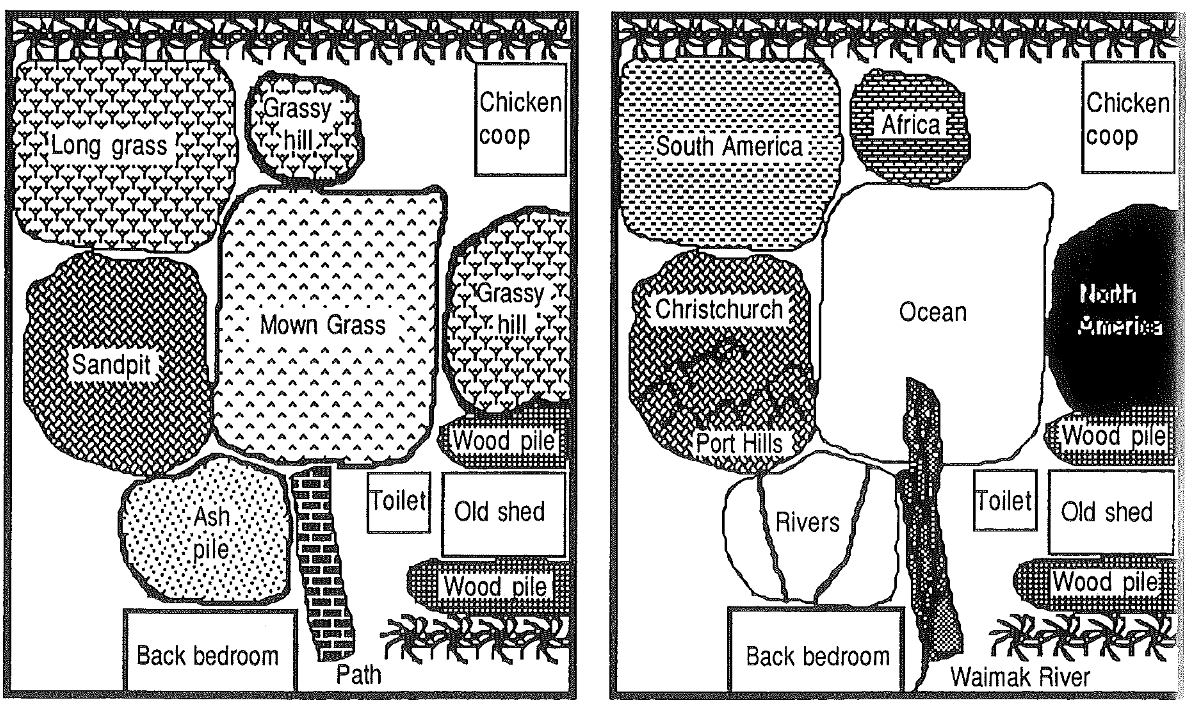


Figure 1.3. The Author's back yard. Left: as it was. Right: as he imagined it.

My own experiences echo that of Rex Walford. To me, maps both stimulate and satisfy intellectual curiosity. However, the market research conducted by Drewitt, the statements presented by Board and Sylvester and personal observation all warn me that my experience is not typical. Map use is more typically limited to the satisfaction of an immediate need. People are so busy with map interpretation that they have no time to explore further. It may be that successive failures in map interpretation have convinced some that maps are irrelevant to them.

Given this intellectual and personal background, this thesis has three primary goals:

1). To investigate possible causes of difficulties in map interpretation.

2). To provide historical and contemporary explanations of these difficulties.

3). To postulate, examine and test alternative cartographic formulations designed to ease these difficulties.

Reaching the first goal involves consideration of theories of cartographic communication. Explaining the existence of such difficulties requires an analysis of historical and contemporary social formations and their influence on cartography. The third goal can be attained only by an understanding of what sort of cartography might better satisfy people that at present do not use maps successfully. A precis of the discussion follows a consideration of the basic definitions upon which that discussion rests.

Definitions

The thesis introduces a number of important definitions. While many different meanings may be suggested for each subject, the last definition for each concept is the working definition to be used in this thesis discussion.

Cartography

According to the British Cartographic Society there should be two definitions of cartography. One, for use when dealing with the general public, is: "Cartography is the art, science and technology of making maps." The other, for professional cartographers, is: "Cartography is the science and technology of analysing and interpreting geographic relationships, and communicating the results by means of maps" (reported in Harley, 1989: 2).

Two aspects of these definitions are worthy of comment. First, it is stated that professional cartographers construct maps using science and technology alone, but they wish their users to interpret these as art. It may be that the loss of art has contributed to the unfavourable reaction to maps. Second, the latter definition indicates that the privilege of interpreting geographic relationships lies with the cartographer, not the map user. For these two reasons the second definition is unsatisfactory, yet it contains one notion that needs to be added to the first definition; the act of communication. Borrowing from the U.N. Department of Social Affairs (1949), Blakemore (1986), Kirkpatrick (1987) and the populist definition of the British Cartographic Society, the definition of cartography used in this thesis is:

> "Cartography is the process of making maps, including every operation from original survey to final printing of copies, for the purpose of communicating spatial information."

The Map

There are many definitions of what a map is, including Blakemore's:

> "... a structured cartographic representation of selected spatial information, which when placed on to a storage medium becomes a map" (Blakemore, 1986: 277).

Most of these definitions emphasise the technical aspects of the map: that is, they are definitions from the point of view of the map maker. This thesis focuses on map interpretation, yet nothing of the map user is heard in these definitions. Therefore, the definition of a map will be procured from a selection of non-cartographers who use maps.

In 1987 a test was administered by the author to 152 first-year geography university students (Figure 1.4) in which they were asked to select from a group of six images any that, in their opinion, were maps and to comment on the reason for their choices. The results are summarised in Table 1.1.

	number	%
Image 1	152	100.00
Image 2	115	75.70
Image 3	68	44.70
Image 4	77	50.70
Image 5	94	61.80
Image 6	1	0.70
One image	12	7.90
Two images	22	14.50
Three images	47	30.90
Four images	48	31.60
Five images	23	15.10
Six images	0	0.00
	152	100.00

Table 1.1. Which Images are Maps?

Having received limited formal training in the interpretation of topographic maps, it is not surprising that all of the students selected Image 1 as a map. It was surprising, however, to find that (with the exception of Image 6) a substantial number of the students chose each of the other images. In fact, the average number of images chosen per student was 3.32, with 15% classifying five of the six images as maps.

Of course, this simple exercise reveals little about what people in general think a map is. It does, however, alert us to the possibility that a substantial number of people might treat an inaccurate, artistic, stylised, general image that lacks information and detail as a map. This suggests the need for an encompassing, non-technical rather than exclusionist definition of what a map might be. To this end, the map is defined in this thesis as follows:

> "A map can be any graphic representation of the location of spatial phenomena in which spatial relationships can be discerned."

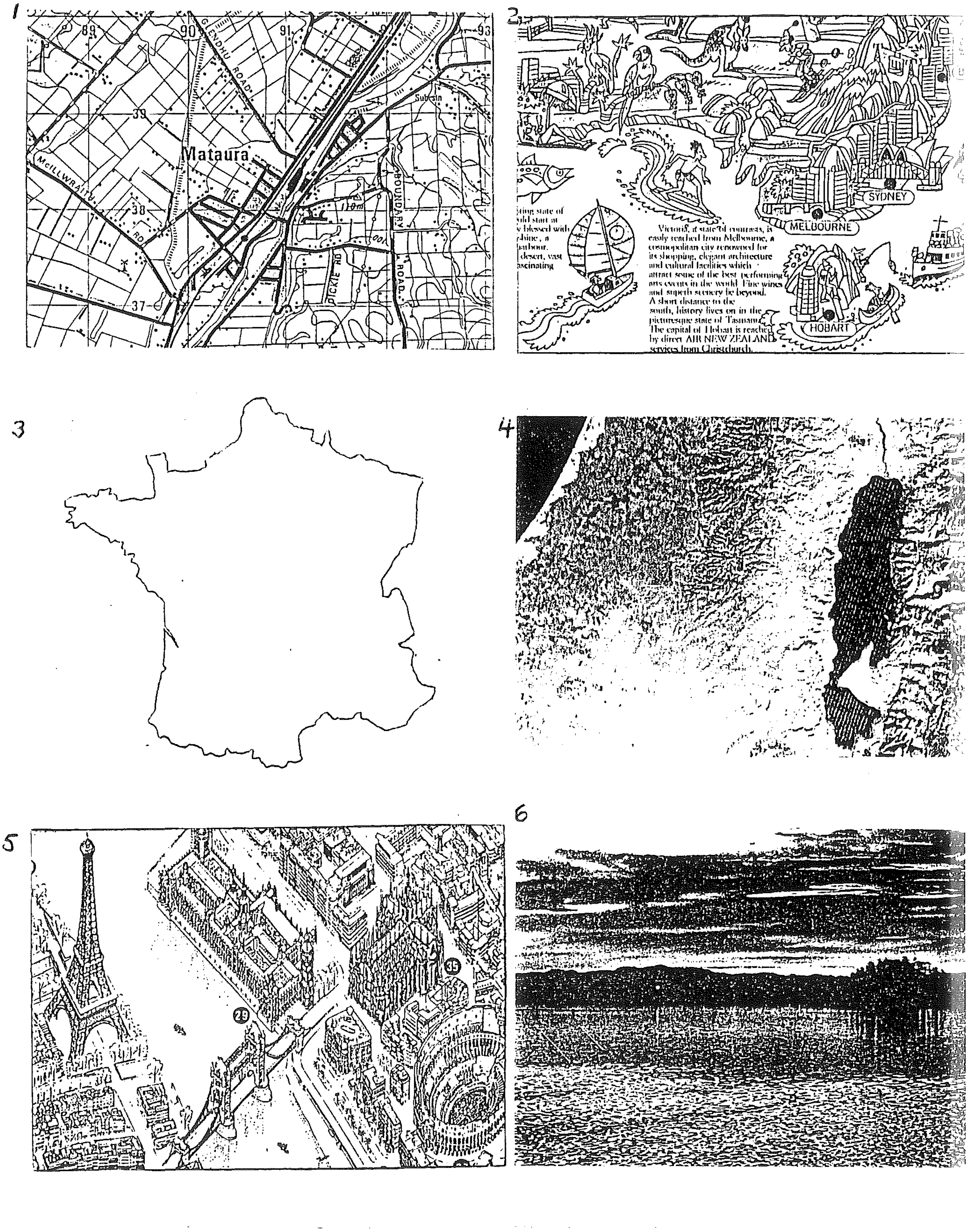


Figure 1.4. Question sheet: Which images are maps? Source: Kirkpatrick, 1987.

Map Generator

The existence of a step in the map communication process prior to the cartographer is introduced in Chapter Three of this thesis. The few studies that allow for this possibility call this step the "Map Author" (Keates, 1982) but this term is misleading. Publishers may encourage and fund writers of books, but that does not make them authors. In the same way, people may commission or in some other way give impetus to the production of a map without actually authoring it. These people are named Map Generators because they are

> "Those persons or groups of people who, by various means, initiate the production of a map."

Map Maker

What is a map maker? A map may be a simple document compiled by one person in a few moments of time or it may be the culmination of years of effort by a team including surveyors, draughtspeople, computer technicians and printers. Anyone involved in any of the operations needed to produce a map is a map maker. All of these map makers (plural) together comprise the map maker (singular). The map maker is, therefore,

> "The person or body of people who complete an operation necessary for the construction of a particular map, once that map has been initiated."

Map User

The present author has previously defined the map user as "Anyone who passively or actively views a map if, as a result of viewing the map a belief, impression, thought or idea is created, changed or reinforced." (Kirkpatrick, 1987: 92). This is unsatisfactory in the context of the present discussion because it implies that the map is only used if the user is affected by it in some way. Any definition of the use of a map should allow for indifference as well as for success or failure. Further, it is difficult to sustain the argument that a passive viewer of a map has 'used' it in any sense of the word. To see something is not necessarily to use it. Therefore, the redefinition of this concept sees it simplified to

> "Anyone who purposefully views a map."

Precis of the Discussion

Conceptually, the thesis falls into four parts.

Part One:

The present chapter introduces the subject matter of this thesis, while Chapter Two reviews a number of perspectives that other writers have thought relevant for cartographic research.

Part Two: First Thesis Goal.

Chapters Three and Four examine theories of cartographic communication, uncovering the extent to which traditional cartographic research has neglected the most important aspects of the mechanics of cartographic communication and the transfer of meaning through maps.

Part Three: Second Thesis Goal.

Chapters Five and Six review the historical development and present condition of cartography, looking at what meanings have actually been transferred and what effects this has had on map users and society in general.

Part Four: Third Thesis Goal.

Chapters Seven and Eight suggest possible alternative cartographic formulations, while Chapter Nine explores more closely theoretical and empirical aspects of some of these suggested improvements. The final chapter summarises the major results and signposts further research.

A review of the literature relevant to cartographic inquiry is the subject of Chapter Two. This literature is grouped into six main perspectives, and an assessment is made of the advantages and shortcomings of each for the present inquiry. A perspective which reflects the thinking of the author of this thesis is discussed and adopted as the framework for inquiry.

In Chapter Three the development of cartographic theory (which is mainly about how people communicate through maps) is found to have major shortcomings. The effect that map form, either in the components of the map or in its overall style, has on the map user is the focus of these cartographic writers, to the neglect of consideration of the effect that the map's subject matter might have. For many cartographic theorists '*how* the map's message is communicated' subsumes '*what* is communicated'. This is shown to mean that, at best, cartographic theory invites the cartographer to reform rather than to revolutionise the type of messages society receives from the map. It is argued that the generator of map communication plays a determining role in what is communicated and how it is communicated. This implies that the message of the map generator may conflict with the needs of the map user, suggesting a possible reason for user misunderstanding. The argument is summarised by a model of the mechanics of cartographic communication.

Chapter Four examines in more detail one promising linguistic theory of communication to assess its contribution to the understanding of how meaning is transferred. The principles of Relevance Theory (Sperber and Wilson, 1986) are applied to cartographic communication and are found to offer new insight into how maps communicate and fail to communicate ideas. The discussion highlights further possibilities for users to misunderstand the intentions of those who produce maps.

Chapters Five and Six review the origin, development and present application of cartography in western society. Rather than present a detailed analysis of what tasks maps are presently used for, which various writers have argued should be done (Aitken *et al*, 1985; Petchenik, 1985) but which would beg the question of their non-use, this historical and contemporary review seeks to illuminate the reasons why our society sponsors the types of maps it does. Chapter Five uncovers a geometrical revolution that has underpinned cartography in western society from the Renaissance onwards, strongly influencing the character of maps towards visible, tangible, exploitative and physical subjects at the expense of human factors. Chapter Six shows that this type of map is impositional, both in the subject matter chosen for map communication and the form this communication takes. Specific maps, and user reaction to them, are analysed to show how impositional cartography reduces user interest in maps.

Chapter Seven examines more closely the present domain of the cartographer, the reconstitution of selected spatial data into a map for communication. A matrix is drawn to summarise traditional and alternative types of representation. This device allows discussion of situations for which each type of map has merit. A few selected map types are tested with regard to their applicability for certain tasks, and the discussion these tests generate concludes the chapter.

This thesis will show that the subject matter, or content, of maps is at least as important as map form. The identification and gathering of data to be mapped is called deconstitution, and is discussed at various places in this work. A selection of alternative deconstitutions, presented to demonstrate the possibility of user-driven subject selection and data collection, is the subject of Chapter Eight.

Chapter Nine details the construction, testing and results of a user-driven Geographic Information System. This system attempts to put much of the power to deconstitute and reconstitute spatial data into the hands of the map user, with the object of producing more relevant maps. This chapter specifically addresses the third thesis goal, attempting to allow users to put themselves on the map.

In Chapter Ten the three thesis goals are reviewed in the light of subsequent discussion. How satisfactorily have they been considered? What are the main contributions of this thesis? What further work needs to be done to refine or refute the arguments presented here? Have any interesting research leads arisen? This review concludes the thesis.

Chapter Two

A Framework for Inquiry

Introduction

The primary function of this chapter is to review geographic and cartographic literature that might prove helpful in the pursuit of the three goals of this thesis. This literature has been grouped into six categories or perspectives: positivism, behaviouralism, gestalt theory, phenomenology, structural marxism and post-modernism. Each perspective will be examined in turn for the insights it can provide, with a view to selecting a perspective within which the present research can be situated.

No inquiry of this type should begin without consideration of its underlying philosophy and methodology. This is because no research is conducted independently of the fundamental beliefs of the individual scientist or of the milieu of the society in which the research is situated. This chapter establishes the existence and nature of the presuppositions behind cartographic and geographic research relevant to the achievement of the thesis goals. Because they affect the research, the fundamental beliefs of the present researcher are also presented.

This chapter exposes three main themes of general interest to geographers. These three themes influence the nature of the discussion throughout this thesis. They are:

1). The tension between human agency and social structure that is behind any human action.

One of the distinguishing features of geographical research is its concern with the motives and outcomes of human actions as they relate to the physical and/or social environment. These human actions may take place at any scale from micro- to macro-scale. These actions are part of human society, and influence and are influenced by the structures we have created to organise our society. In examining any specific action or set of actions, it is difficult for the researcher to separate elements of human agency from the constraining influence of social structure. This thesis is concerned both with the causes and results of specific human actions (generally communicative actions) and with the influences of social structures themselves shaped by human action. The perspective chosen for use in this thesis should make the tension between human agency and social structure overt wherever possible.

2). The linkage between research and social change, whether recognised or unrecognised by the researcher.

The myth of objective science has been exposed by numerous writers, and the warnings of writers such as Bronowski need to be taken seriously:

> "Reality is not an exhibit for man's inspection, labeled 'Do not Touch'. There are no appearances to be photographed, no experiences to be copied, in which we do not take part. Science, like art, is not a copy of nature but a re-creation of her" (Bronowski, 1965: 20).

The research act modifies both the researcher and that being researched. For this reason no research can be isolated conceptually from the society in which it is conducted. Indeed, research modifies and is modified by that society, and either changes that society in some way or works to preserve the social status quo. The present project is no different and, at a number of appropriate places in the discussion, the present author's own feelings and reactions are presented as factors contributing to research formulation and results. The perspective adopted in this thesis should make no claims to objectivity, instead having the capacity to admit its own agenda for social change.

3). The production of messages for reasons different to those influencing their consumption.

It is not possible to apply models about human behaviour constructed from assumptions about perfect knowledge and rational behaviour to a world of inequalities, hidden motives and agendas. Any geographical theory involving human behavioural assumptions must take account of such imperfections. Theories of cartographic communication are concerned as much with the production and consumption of messages as with the medium through which that message is transferred, and so are required to consider the agendas behind message production as well as the motives of the consumers of map messages. Any perspective used in this thesis must be flexible enough to allow consideration of human motives and interactions.

Each of these themes are discussed in relation to the various perspectives adopted by past and present researchers in the cartographic arena. Six such perspectives are considered in this chapter. A seventh perspective, called 'interaction ritual' by its progenitor, Erving Goffman

(1967), is then introduced. This is the perspective closest to what the present author himself believes about the nature of human reality.

A brief discussion on the nature of presuppositions will serve to introduce a consideration of the seven perspectives and three themes.

The Presuppositional Hierarchy

Three types of presupposition are brought to bear on any research topic. A number of theories of knowledge (*epistemologies*) and definitions of what can be known (*ontologies*) often consciously or unconsciously help determine the means of acquiring information and knowledge (Johnston, 1989). A fundamental category that affects the choice of topic and the way in which research is conducted is *cosmology*, defined by Harrison and Livingstone as 'fundamental beliefs about the origin of reality' (Harrison and Livingstone, 1980).

How do all the presuppositions that researchers bring to their task interrelate with each other and the research at hand? Harrison and Livingstone (1980) have used a diagram they call 'the Presuppositional Hierarchy' to illustrate some of these relationships. Consideration of this diagram in the light of the present research task will aid the discussion in illuminating the strengths and weaknesses of various philosophical approaches that could be applied to the research.

The 'Presuppositional Hierarchy' is shown in Figure 2.1. The further down the hierarchy (the 'iceberg' in the diagram) a concept, the more fundamental it is to the research. Those concepts in the shaded part of the diagram (below the 'water') are the "tacit first premises that colour even the most carefully sheltered investigations" (Harrison and Livingstone, 1980: 26).

A typical, though simplified, research inquiry might begin by the choice of topic. This is usually defined in terms of the *discipline* from which the inquiry is launched. The way in which the topic is approached to yield knowledge is called a *methodology*. Cosmological and ontological presuppositions combine (albeit unconsciously, in many cases) to produce "specific epistemological dictates which restrict the kinds of techniques that constitute a methodology" (Harrison and Livingstone, 1980: 26). There is a circular 'feedback' mechanism operating which means that these same dictates act as 'conceptual categories' within which the *results* of the research must be fitted (Harrison and Livingstone, 1980). So at each stage of a typical research formation (Disciplinary, Methodology and Results) the hidden but weightier considerations of the 'iceberg' play an important role in the type, method and shape of research. Any formal geographical philosophy that does not include an attempt to identify and examine its underlying presuppositions is bound to fall into errors of circularity, where results are determined more by the presuppositional constraints of the inquiry than the nature of that which is studied. Harrison and Livingstone amplify this by saying:

> "Rather than discovering new knowledge, the problem is one of the subjectification of epistemological principles and the postulation of *a priori* frames of thought into which 'the knowledge we acquire observationally is fitted'" (Harrison and Livingstone, 1980: 26).

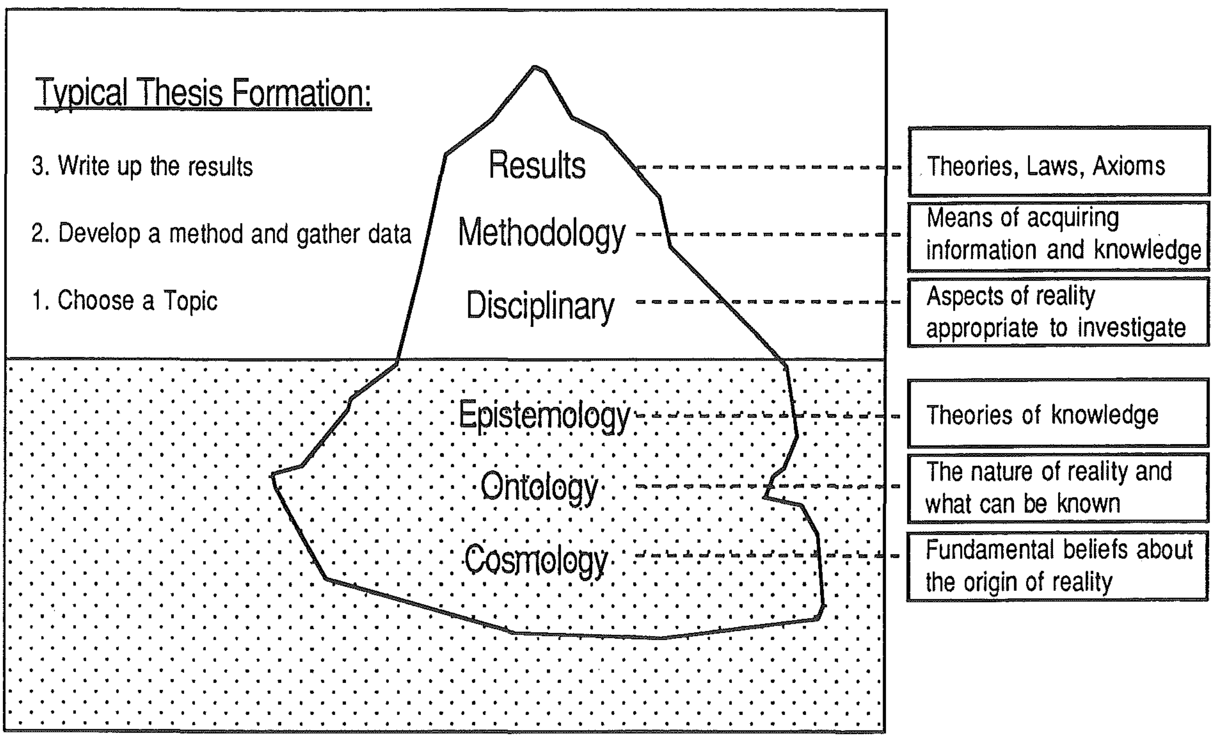


Figure 2.1. The Presuppositional Hierarchy. Source: after Harrison and Livingstone, 1980.

In considering six perspectives used by writers to frame discussions about cartographic matters, reference will be made to the underlying assumptions of each about human agency and social structure, the link between the research and social goals, and the production and consumption of communication. In most cases the writers working from within each perspective do not articulate their theories of knowledge or their fundamental beliefs about the origin and nature of reality. It is, however, possible to make broad statements about the type of beliefs characterising each perspective, at least as the present author perceives them. The articulation of these fundamental assumptions and beliefs allow the researcher to ascribe limits to each perspective beyond which research findings cannot be taken. This is important in a consideration of cartographic research, ensuring that no findings are taken out of context.

Six Perspectives on Cartography

Positivism

Positivism is comprised of five basic features. These features are: *empiricism,* the idea that real-world facts 'speak for themselves' and can be true or false on their own, without allowing for presuppositions or ideologies; *unitary scientific method,* which would amalgamate all scientists under one methodological banner; *universal laws,* empirically verifiable laws generalised from specific observations; *objectivity of observation,* which disallows any statement (such as value judgments) incapable of being empirically tested; and the *unification of universal laws into a single system.*

Following the 19th century work of Comte and Saint-Simon, investigators adopted positivism as a method to distinguish science from metaphysical and religious considerations (Gregory, 1978). Many degrees of positivist science exist both as formal constructs and as informally held methods by individual researchers. The 'Quantitative Revolution' which affected geography in the 1950's and 60's, and transformed cartography from the 1960's to the present, was loosely based on a derivative of positivism called logical positivism. The incorporation of mathematically verifiable truth meant that empiricism had to be relaxed to the extent that some statements could be verified by logic without having to resort to empirical assessment.

The vast majority of research into matters of cartographic concern has been conducted with a positivist perspective. This perspective was seldom deliberately chosen as the most appropriate for the task, but followed from the nature of cartographic research interests and the motivations of the cartographic research community. It is argued that positivism was chosen not primarily because of the research advantages it conferred but because it gained privilege for the discipline as a 'hard' science, attracting finance because of this status.

The historical context of the adoption of positivism includes post-World War Two restructuring which promoted scientific mapping as having an important role to play in the vision of technology-led recovery through resource development. Advantages were seen in developing an overall cartographic theory from which axioms about the behaviour of map users could be generalised (Scott, 1986). It was hoped that finance would be attracted in a competitive environment by this change in perception of cartography from an art to a science. The search for a theory to govern cartographic research led initially to stimulus-response (S-R) theory (Stevens and Galanter, 1957), in which the map user was isolated from sources of external stimuli and the various elements of a map were advanced for interpretation one at a time. This experimentation was designed to discover the mathematical relationship between actual and perceived characteristics of map symbols in order to construct generalisable theory.

Two problems, characteristic of much reductionist research, manifested themselves in S-R studies. Research was conducted outside of the context of the map users' environment, and cartographic variables were isolated from the map. The work contributed little to the knowledge of map communication.

The next generalisable theory that cartographers sought in order to legitimate their science was borrowed from electronic engineering. The use of 'information theory' in the 1960's and '70's, and even up to the present, represents a serious error: it is an uncritical application of a natural science methodology to the study of human interactions. Information theory suggested that good cartographic communication was analogous to clear electronic communication while 'interference' or 'noise' made the communication less meaningful. As an analogy information theory serves to illuminate a number of important principles of information, but its unquestioned (and untested) application to all areas of cartographic communication led to further error. Concerned with the dynamics of the message alone, it inhibited consideration of the motives of the 'transmitter' or the impact the message might have on the 'receiver'. That is, misunderstanding can still arise even though the communication system might be working perfectly well. Thus those who apply the theory to the study of cartographic communication might well clear away all the 'noise' in the system but be no closer to enabling the map user to understand the map message. Information theory fails to provide an adequate base from which the third theme of this thesis, the production and consumption of communication, can be examined.

The fascination with such a mechanical analogy allowed the cartographic theorist to develop a closed system in which events took place in an ordered sequence, determined by the cartographer. This facilitated simple empirical research, the goal of the 'quantitative revolution' in which geography (and cartography) sought to be regarded on equal terms with physical sciences. The positivist theories generated by this research were designed to predict events: the suitability of particular maps to map users.

The underlying presuppositions of this type of research can be summarised as follows: positivism is a tool used by those involved in the map making process with certain beliefs about what people and society should be like. It is argued that the financial sponsors of positivist cartographic inquiry sought particular returns for their investment in the form of maps designed to achieve developmental and materialist objectives (Harvey, 1984; Harley, 1989), as exemplified by the following quote from the United Nations Economic and Social Council resolution 131 (vi) of 19 February 1948:

> "...accurate maps are a prerequisite to the proper development of the world resources which in many cases lie in relatively unexplored regions..." (U.N. Department of Social Affairs, 1949: 5).

Positivist research has provided many insightful studies. Empirical work has suggested that many users find elements of maps (such as graduated circles) difficult to understand. The results of these reductionist experiments, in which the participants are confined to laboratory conditions, are not generalisable to anything other than similar laboratory experiments. Within these limits positivist research can reveal potential areas of investigation using methodologies more suited to real-world conditions. However, as a systematic body of knowledge positivist cartographic research neither answers or even addresses the basic questions of why society has the type of maps it does (and why many people misunderstand the messages they contain), nor does it provide meaningful avenues of exploration into providing maps that might better stimulate and inform their users.

Behaviouralism

An outgrowth of the positivism practiced in the quantitative revolution (Bunting and Guelke, 1979), behaviouralism in geography attempts to examine empirically human cognitive processes and relate these processes to human-environment interaction. In examining the ways in which humans process information behaviouralists began exploring the idea of 'mental maps'. These egocentric cognitive images used by individuals in spatial decision-making were an example of how humans abstracted, structured and stored spatial information. As early as 1913 a commentator, Charles Trowbridge, recognised this.

> "Some people, he thought, had informal, imaginary maps in their heads centred on the locations of their homes. They were able to move around the urban landscape as long as they remained on familiar ground, but they quickly became disoriented in unfamiliar areas. Others appeared to be egocentric, and see directions in relation to their own position at the moment. These people seemed to be able to navigate much more surely..." (Gould and White, 1975: 28).

The concept has since been amplified and refined, having been the subject of much empirical testing as the following reveals:

> "Internal representations may be studied indirectly, by asking people to report spatial information as they remember it. Although the reported information will not contain all details about the environment, it will indicate certain structural relationships, such as relative distance (scale) and direction (orientation) between remembered features. These relationships give the reported information a map-like character. Because it reflects an internal, spatial memory, the external reported information reflects a cognitive process, and so is called a cognitive map" (Buttenfield, 1986: 238).

The idea of mental maps was picked up by geographers from the late 1960's as a way of analysing spatial decision-making (Gould and White, 1975) and, more problematically, used by psychologists as a method of measuring distortion in human perception in order to better inform theorists as to the nature of map interpretation (Thorndyke and Stanz, 1980). Psychologists have conducted a great many experiments in this area, systematically attempting to define "distortions in judged spatial relations" (the title of a paper by Albert Stevens and Patty Coupe (1978); see also Sadalla, Burroughs and Staplin, 1980; Evans and Pezdek, 1980; Tversky, 1981; and Moar and Bower, 1983). Geographers conducted analyses of similar 'distortions' in map use (Waterman and Gordon, 1984; Magana, Evans and Romney, 1981) and have used them to inform small-scale geographic study (Golledge, Riuizzigno and Spector, 1976). This research was seen as socially beneficial: it was hoped, for example, that results from behavioural studies might help decision makers and planners design better built environments for urban dwellers.

The idea that humans perceive their environment in recognisably patterned ways is a powerful one and will be pursued in this thesis. In particular, Thorndyke and Hayes-Roth point to a clear distinction between procedures used in making spatial judgments using knowledge acquired from maps and those based on knowledge acquired from personal navigational experience. This research anticipates different results from different spatial learning procedures. These results are influenced by the different *perspective* presented by these learning procedures: a vertical view from a map, in which "the individual views... from above and outside of the depicted space"; while "during navigation, on the other hand, the individual acquires procedural knowledge of the environment", a horizontal view (Thorndyke and Hayes-Roth, 1982). This idea forms a basis for investigation in Chapter Seven of the thesis.

Allied to this is the usefulness of this research in pointing out that a strict Euclidean distance metric is not the only, or even the most appropriate way of looking at spatial relationships. Gould and White could write in the 1970's that

> "geographers are increasingly looking at questions of relative location - questions which consider places not in any absolute, old-fashioned, latitude and longitude sense, but in terms of their costs and times to all other places with which they might exchange goods, money, people and messages" (Gould and White, 1975: 15).

The research conducted by behaviouralists has been criticised for its positivist assumptions (Bunting and Guelke, 1979; Cox and Golledge, 1981; Couclelis and Golledge, 1983). The research clearly separates subject and object, assessing the subject's mechanical responses to stimuli divorced from environmental context:

> "Perhaps unintentionally, the impression frequently given is that the experimental subject is a sensitised screen on to which the researcher projects some cartographic material in order to measure the result" (Griffin, 1983: 101).

This form of reductionism plagues the psychology literature in particular where, typically, experiments involving "10 undergraduate students... who volunteered in response to a campus advertisement" choosing between "two sets of stimuli" from which generalisable results are found (Stevens and Coupe, 1978: 425-426). Again, while each experiment may hint at underlying patterns and processes, any attempt to formulate generalisations and universal laws is foiled by the artificial separation of subject and object from the environment in which they normally make spatial decisions. These criticisms help explain why, in reviewing the progress of cartography and mapping in 1981, Mark Monmonier noted

> "... a growing realisation that psychophysical and some other perceptual-cognitive studies of map use seem to have promised more than can be delivered" (Monmonier, 1982: 441).

Related criticism is directed at mental mapping research:

> "Unfortunately, because of serious methodological limitations, the internal validity is so weak in much of the cognitive mapping research that it is difficult to draw definitive conclusions about how these cognitive processes function. For example, does a hand-drawn map adequately reflect the information stored in memory for a particular setting; and, assuming that it does, how does one analyse this kind of data?" (Evans and Pezdek, 1980: 13).

Geographers have agreed with this assessment, with Robert Sack arguing:

> "...researchers have equivocated about whether the cognitive maps are in fact visualised by the decision-makers and whether decision-makers use relationships about the physical world which can be represented in map form" (Sack, 1980: 98-99).

Research into mental maps and the implications of human cognitive activity for mapmakers appears to be an important avenue of inquiry. However, the behaviouralist research methods are likely to uncover nothing more significant than possible relationships (observations). They do not succeed in convincingly explaining them or relating them to the everyday tasks for which people might use maps, cognitive or otherwise. They are open to the same criticisms leveled at positivist research, of which they are a subset.

Gestalt Research

A third outgrowth of positivistic thought is gestalt research. It is named after the Gestalt school of psychologists who held that "the objects which we view in the world have a different meaning when viewed as a whole rather than as individual parts" (Billinge, 1986: 26). Such inquiry is constituted to avoid reductionist errors characterising much positivist research.

Typically, gestalt research uses eye-movement studies to examine how users gain information from maps. It is argued that a succession of retinal images are compressed into a single impression of map form. People learn not by isolating specific bits of information, but by 'comprehending the whole'. They store in their brain the activity of synthesising the perceived object rather than the perceived object itself. Recall involves reconstituting the object/pattern/totality from the parallel and sequential processing that implanted the cognition in the brain in the first place (Robinson and Petchenik, 1976).

This is a significantly different description of how map users might gain information from maps. Hywel Davies (1985) argues that

> "Through the greater understanding this conferred, it is now better appreciated not only that clearer map signs are needed, but that distinctive skills are required in map reading" (Davies, 1985: 13).

It may be, then, that gestalt research can indicate how maps can be constructed as totalities or wholes to enable users to better comprehend their messages. By emphasising the relationship between individual map elements (figures) and the map itself (the ground) made up of all of the map elements, this research suggests a complexity in map reading not conceived by positivist researchers. It informs us that reductionist experiments, divorced from the context of the use to which a map should be put and the environment in which it typically exists, are unlikely to reveal anything meaningful about cartographic communication.

By implication, gestalt theory has alerted researchers to the existence of an 'overall' message of the map, which may be intentionally or unintentionally different to that of the 'sum of the parts'. While not themselves gestalt researchers, Denis Wood and John Fels present an illuminating discussion on the hidden messages encoded in a simple highway map of North Carolina (1986). Ostensibly an aid to navigation, this map is shown to have a number of peripheral drawings and text designed to advertise North Carolina as a state worth travelling in (Wood and Fels, 1986). J.B. Harley comments on this map:

> "I am not saying that these elements hinder the traveller from getting from point A to B, but that there is a second text within the map" (Harley, 1989: 9).

By alerting cartographers to the possibility of more than one level of message in the map (levels which may, in fact, contradict each other or cause confusion in the user), these writers advance our understanding of why map users may react more positively to some map presentations than to others. This has relevance to the issue examined in this thesis and will be examined more closely in the following chapter.

The study of map reading by map 'percipients' using interpretations of eye-movements is a tenuous surrogate for the (at present) objectively unmeasurable events taking place in the brain. As such, it is open to similar criticism to that leveled at the cognitive mapping research of behaviouralists.

Gestalt research provides an incomplete understanding of the production and consumption of the map message. Researchers in this field have not pursued the relationship between the 'overall' map message and the messages of its component parts, preferring instead to use gestalt techniques to measure the rate of map comprehension by map users. The issue under investigation in this thesis has as much to do with the *relevance* of the map message as with the *competence* of this message, the issue of concern to gestalt researchers. Analysing the competency of users to interpret maps tells the researcher nothing about whether the information is actually meaningful to map users. Gestalt research has revealed a possible cause of misinterpretation by uncovering layers of messages in maps, but has neither revealed the source of these messages nor examined their effect on the map user.

Phenomenology

Phenomenologist geographers (some, but not all of whom call themselves 'humanistic geographers') study the 'essential' nature of entities/phenomena while rejecting the separation of subject (observer) and object (observed). Rather than discussing 'people' and 'environment' as separate entities, phenomenologists investigate the relationship between the two as a subject of study:

> "As a scientific approach, it is concerned with uncovering the truth regarding people's experiential relationship with place" (Hasson, 1984: 11).

The concepts of space as a theoretical construct and place as experiential reality are clearly defined and distinguished (Smith, 1979).

Phenomenology purports to investigate issues of relevance to the everyday lives of people. Researchers using this philosophy seek to interpret the meanings of people's lives in their environment in order to make the empirical component of science relevant to the 'lived world'. While no cartographic studies have been conducted using phenomenology as a philosophy, it appears as though phenomenological research may enable the discussion to make a closer approximation to reality than that of the philosophies hitherto considered. The definition of relevance as *matters pertaining to the lived world* may serve to inform the direction of relevant cartographic research, avoiding the problems associated with reductionist positivistic methodologies.

Phenomenologists assert the fundamentality of human actions and values:

> "In its challenge of rational positivism, humanistic geography questions the very possibility that people's relationships with place and space can be understood without grasping their feelings, emotions, values and intentions" (Hasson, 1984: 11).

This sort of writing promises research that reveals individual motives and emotional reactions to the environment. It seems that phenomenology, mediated by humanist geographers, offers a hope of understanding how the message of the map might affect the map user in his or her 'lived world'. If research conducted in the phenomenological context is to be followed, the way to achieve that understanding lies in observation, interrogation and reporting of the human reaction to, and purposes for, map communication.

Strangely, then, practitioners of humanistic geography seem to have ignored research into the map. In fact Peter Gould, here speaking against using mental 'templates' to structure knowledge, says that we should not project

> "... the multidimensional character that characterises the complexity of contemporary life on to the traditional space of the geographic map" (Gould, 1981: 174).

Torsten Hägerstrand, however, issues this challenge: he wants cartographers to "... rise up from the flat map with its static patterns and think of a world on the move" (Hägerstrand, 1983). Both writers see the map as restrictive in its present form, criticism that is directed at the sort of map image promoted by Kingsbury in Chapter One. If these writers are representative of this perspective, phenomenologists wish to see dynamic maps that reflect a human world of motion and flux. The possibility of such maps is the subject of Chapters Seven, Eight and Nine.

Phenomenology as interpreted by humanistic geographers has been criticised by structuralist writers as lacking a clear explanation of the role of social structure. While informative and revealing about the individual's relationship to the lived world, ""... it fails to take seriously the society external to the individual" (Smith, 1979: 367). Social structures may have an important role to play in mediating the social conditions within which individual-environment interactions take place, thus profoundly affecting those interactions. Because humanistic geographers place so much emphasis on the individual, their work tends in the eyes of critics to underestimate the influence of constraining social forces.

Although in theory it is a powerful critique of positivism, phenomenology is a reformation of empirical study rather than a revolution against it. It has extended the subject matter of study to include non-empirically verifiable feelings and values but offers no way to interpret them: "humanism tries to address man 'scientifically' but does so outside of all frameworks" (Christensen, 1982: 51). However, the social context of the empirical component has been underemphasised or ignored. In which context, therefore, are phenomenological entities to be interpreted? Without context, feelings and values have little meaning to anyone other than those who feel or hold them.

The phenomenological perspective warns us to take the feelings and values of individuals into account in any research involving humans. This is a powerful contribution to this thesis discussion. The next perspective under review places observations in a clearly defined social context.

Structural Marxism

David Harvey suggests that the historical analysis of social structure informs the present condition of geography and proposals for its transformation (Harvey, 1984). This analysis is derived from structuralism, a philosophy which is continually

> "... moving beneath the visible and conscious designs of active human subjects in order to expose an essential logic which is supposed to bind these designs together in enduring structures, which are recoverable through a set of purely intellectual operations" (Gregory, 1986: 461).

Gregory's statement bears amplification. Originating in the linguistic philosophy of Claude Levi-Strauss , structuralism is another post-positivist perspective adopted in geography as much in reaction to positivist explanation as a vehicle of explanation in its own right. Although it is most closely identified with structural Marxian economics (through Piaget and Althusser), structuralism is in fact an amalgam of concepts. Further, it is an epistemology without any clearly constructed research methodology. It is a prism through which the light gained from any form of research might be shone in order to reveal its true colours. It forms one substantial component of critical theory, interpreting present conditions in an historical context.

Those who write from the structural marxist perspective make a major contribution to the present research by critically assessing the historical use of maps as tools promoted and used to advance particular social goals:

> "Concern for accuracy of navigation and the definition of territorial rights... meant that mapping and cadastral survey became basic tools of the geographer's art... the cartographic basis was laid for the imposition of capitalist forms of such rights in areas of the world that had previously lacked them" (Harvey, 1984: 2).

This is a powerful insight into the historical reasons for the existence of the types of maps in use in contemporary western societies.

Marxist thought alerts us to the need to place all study in a social and historical context. "The form and content of geographical knowledge cannot be understood independently of the social basis for the production and use of that knowledge" (Harvey, 1984: 2). 'Why do maps exist?' Harvey could be asking. 'To what use have they been put?' For what reasons do maps play an important regulatory part in contemporary western society? Whose interests do they serve? These questions are pertinent to the issue this thesis examines. Significantly, it is a concern with social structure rather than human agency that brings these questions to our attention.

Having already been alerted by gestalt theory to the possibility of 'overall' messages in maps, we now begin to see what the intentions of these messages might be. Rather than an aid to the understanding of the 'figures' of the map, this message is often, consciously or unconsciously, an attempt to control or influence the map user in some way beneficial to the generator of the map.

A structural marxist reading of the history of cartography identifies the social goals of those who sponsor, or generate, cartographic products. The 'overall' message of the map is argued to be one of persuasion in order to gain a measure of power over people and nature. Even critics of structuralism admit "... it is through self-consciously marxian analysis in geography that discussions of power have been introduced" (Duncan and Ley, 1982: 31). This argument is explored further in the next chapter.

This perspective admits no claims to value-free, neutral science. Harvey writes:

> "Geographers cannot remain neutral. But they can strive towards scientific rigour, integrity and honesty. The difference between the two commitments must be understood. There are many windows from which to view the same world, but scientific integrity demands that we faithfully record and analyse what we see from any one of them" (Harvey, 1984: 7).

Harvey makes no pretence of neutrality, instead overtly advocating a geography reformulated to achieve social change. Speaking about his prescription for "the unification of geographical sensitivities and understandings", he claims that such a project "is fundamental to our thinking on the prospects for the transition to socialism" (Harvey, 1984: 9). Harvey spells out his prescription:

> "The geography we make must be a people's geography, not based on pious universalisms, ideals, and good intents, but a more mundane enterprise that reflects earthly interests and claims, that confronts its ideologies and prejudices as they really are, that faithfully mirrors the complex weave of competition, struggle and co-operation within the shifting social and physical landscape of the twentieth century" (Harvey, 1984: 7).

Of special interest to us is his prescription for the future of the map:

> "The more mundane techniques, such as mapping... appeared recuperable if not unavoidable to any reconstitution of geographic practice. The problem was to shake them free from their purely positivist presentation and integrate them into some other framework" (Harvey, 1984: 6).

This is the origin of the third goal of this thesis. Chapters Three through Six are written to demonstrate the need for such a reformulation, while Chapters Seven through Nine attempt it. However, for the following reasons the 'other framework' used in this thesis is not structural marxism.

James Duncan and David Ley (1982), among others, point out two serious deficiencies in a purely structural approach to understanding geography. Firstly, they assert that structural marxist analysis subsumes human actions, relegating them to the category of determined responses to structural imperatives. The efficacy of human agency is thereby evicted from human history (Gregory, 1978).

Because human action is relegated to a passive or responsive role, marxist writers have often reified structures as actors: "... reified entities such as capital are treated as the formal cause while people are regarded as the efficient cause, the mere carriers of a structural logic" (Duncan and Ley, 1982: 30). These writers produce a number of examples of reification in the writing of structural marxists, such as that of Castells, 1977:

> "But if the representatives of a social class do not always know how to recognise themselves, the class itself knows its own interests, in the sense that its unconscious logic tends to sweep away whatever does not serve its interests" (Castells, 1977: 320, cited in Duncan and Ley, 1982: 36).

The writer here distinguishes between people and their class and asserts that it is class, not the people, which acts in its own interests. This is a confusion of the relationship between human agency and social structure.

In summary, structural marxist theory appears to offer valuable insight towards reaching the first two thesis goals, examining the reasons why people have difficulty interpreting the map message and suggesting historical explanations for these difficulties. However, the subjugation of human agency and consequent reification of structures make any attempt to pursue a purely structuralist cartographic solution to this problem fraught with difficulty.

Post-modernism

In contrast to structural marxism, post-modernism offers a great deal of flexibility in its theoretical construct, because that construct has not been unified into any cohesive philosophical structure. It is, its proponents argue, a slowly emerging intellectual and cultural transformation for which the term 'post-modern' is merely a covering label. Rather than being an alternative perspective, post-modernism is the express lack of a perspective. This lack of cohesiveness is the inevitable result of a perspective whose practitioners deny the possibility of a useful overall theoretical structure: "Not only does the post-modernist work claim no such authority, it actively seeks to undermine all such claims: hence, its generally deconstructive thrust" (Owens, 1983: 58).

Post-modernist writing can be read as an overt rebellion against the institutes of western society derived from the 'Enlightenment Project'

(Harvey, 1989, Gregory, 1989), the era of the rise of western hegemony and of the natural sciences, and their attempted separation from that which was overtly moral and/or religious. The great themes of the modernist (post-Enlightenment) era lose their credibility under this critique. Far from acting as a unifying theory, "post-modernism privileged heterogeneity and difference as liberative forces" (Harvey, 1989: 9). For the post-modernist, unified representations of the world give way to "perpetually shifting fragments" (Harvey, 1989: 52).

Based largely on the work of French writers Foucault and Derrida, the geographers considering postmodern thought focus their critique on what they call 'meta-theory' or *'discourse'*. The use of the word discourse derives from their interpretation of theory-building as an on-going conversation. They embrace the idea of *'deconstruction'*, a method of examining the discourse or text for clues to the hidden meanings or agendas written into it. Every discourse, it is argued, has within it a tension "between what it manifestly *means to say* and what it is nonetheless *constrained to mean*" (Norris, 1987; cited in Harley, 1989: 8). Post-modernist writers deconstruct discourses to reveal their true meanings. The terms 'discourse' and 'deconstruction' are two of the most powerful ideas of postmodern thought, undermining rather than outlining a general theory of cartography.

As a critical evaluation of maps in western society, post-modernism uses the deconstructive technique to flesh out the ideas that structural marxist writers had already brought into focus. Harley writes: "... it is possible to view cartography as a discourse - a system which provides a set of values for the representation of knowledge embodied in the images we define as maps and atlases" (Harley, 1989: 12). Specific examples of this discourse can then be deconstructed to reveal specific purposes encoded in the map, leading to the discovery of the set of values cartography represents.

A post-modernist critique of cartographic endeavour reinforces the idea that maps contain an embedded overall purpose. While gestalt theory hinted at the possibility of an 'overall' map message and structural marxism suggested that these messages might be grounded in a particular ideology, post-modern deconstruction reveals them clearly. "We can start to read our maps for alternative and sometimes competing discourses" (Harley, 1989: 15). Harley claims that

> "It is the disjunction between [the embedded social vision of the map] and many alternative visions of what the world is, or what it might be, that has raised questions about the effect of cartography in society" (Harley, 1989: 13-14).

A promising aspect of post-modernism, then, is the allowing of visions other than the dominant social (modernist) vision. This appears to bode well for the research in hand. Further, a reading of David Harvey's (1989) consideration of postmodernity suggests that deconstructing the map to reveal the motives of producers of maps in our society

> "creates the opportunity for popular participation and democratic determinations of cultural values... the cultural producer merely creates raw materials (fragments and elements), leaving it open to consumers to recombine those elements in any way they wish" (Harvey, 1989: 51).

In decentralising the power of contemporary cultural producers, Harvey suggest that consumers - in this case map users - can begin to gain control of the map making process, *reconstructing* maps. This crucial concept was the original reason for the initiation of this Ph.D. thesis and the work reviewed in latter chapters of this thesis turns upon it.

Traditional cartographers might baulk at the prospect of user-driven mapping. Post-modernist thought, however, suggests that it is essential. In architecture, post-modernism is an assertion of the need to build for people rather than for Man (Harvey, 1989). Roland Barthes, a proponent of post-modernist literary criticism, asks us to identify with the act of writing (creation) rather than the act of reading: as Harvey illustrates, it becomes "Mickey Mouse teaching the architects" - populism informing theory. Users ought to be given the chance to draw maps of their own choosing as well as read the maps of others. The frontispiece to <u>Wind in the Willows</u> may be much nearer to what people would create than the sorts of maps cartographers give them.

Finally, at least one postmodern writer dealing explicitly with cartography identifies the mistaken belief held by cartographers that it is they who initiate map communication. This 'myth of cartographers' centrality' is revealed by Harley, who writes:

> "Behind most cartographers there is a patron; in innumerable instances the mapmakers of cartographic texts were responding to external needs... Monarchs, ministers, state institutions, the Church, have all initiated programs of mapping for their own ends" (Harley, 1989: 12).

This revelation of a hitherto ignored component of cartographic communication allows the critical researcher to identify power relations as beginning with the initiator, or generator, of the map message. The role of the map generator is investigated in the next chapter.

One of the criticisms brought against post-modernism is that it tends to focus on style rather than substance. In the same way that post-modern architecture merely frames a building that may serve the same impositional function as the modernist building next door, so it can be argued that post-modernist reconstruction may not ameliorate the message of the underlying discourse so much as its medium of expression. So while maps themselves may be reconstructed, they may contain the same messages of control as the modernist cartography they are designed to replace.

This problem arises because global theory is ruled out of court. Harvey (1989) argues that rather than removing global scale philosophy, it merely pushes it underground - the place where it works best. This, Harvey suggests, disempowers the very groups it recognises as legitimate, leaving the practitioners of methods of control free to continue unimpeded.

Of practical concern to the present research enterprise is the nihilistic nature of much post-modern evaluation. For example, Europeans have "lost their ear for cartography", the genre is "used up" and so post-modern artists using the map have "abandoned the territory altogether or sought alternative [non-cartographic] ways and means of representing it" by "challeng[ing] the hegemony of the visible by empowering the other sense, frustrating sight", leading to the tired conclusion: "perhaps the world is mapped out." These quotes come from the catalogue essay accompanying an art display entitled Putting the Land on the Map: Art and Cartography in New Zealand since 1840 (Curnow, 1989). Curnow remains sceptical of the continued use of maps as themes by artists, let alone by the general public. Post-modernism promises much but delivers a method of literary criticism with problematic results for this research exercise. Those whose self-appointed task it is to be critics *alone* of modern society may have no need to conduct reconstructive research, but the geographer who, like myself, believes that reconstruction is both possible and necessary has to actually do something about it.

The Perspectives Reviewed

Though this discussion has not done justice to the breadth and detail of the perspectives under review, it is possible to list a number of insights gained from them as well as recognising agendas for and cautions to research. This section provides a summary of the main points of the six perspectives, summarising their insights, agendas and cautions.

Figure 2.2 is a graphic summary of the contrasts contained in the perspectives we have reviewed. Each sliding scale represents the position of the perspectives on a continuum between opposite outcomes of the three themes mentioned at the beginning of this chapter. This enables the reader to identify the major traits of each perspective as it relates to this thesis.

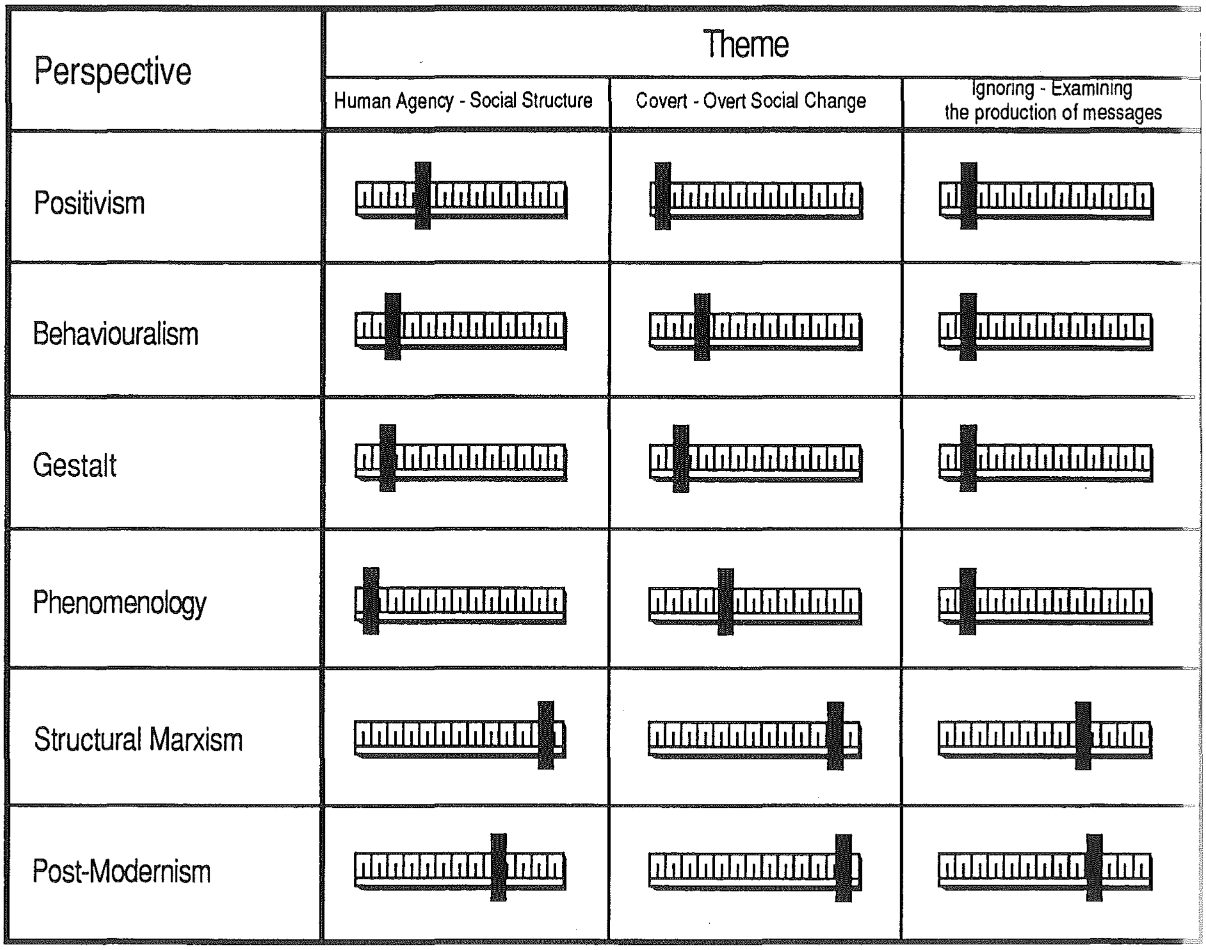


Figure 2.2. Summary of how each perspective dealt with the three themes.

This reviewer would judge a perspective as adequate for use as a framework in this thesis if the first sliding scale, human agency vs, social structure, were to be set roughly in the middle, while the other two scales were set further to the right. No one perspective meets these criteria, with post-modernism perhaps coming the closest. This diagram was not meant as a framework-selecting heuristic, however. It merely allows visual comparison between three aspects of the six perspectives.

Insights

We begin with a recognition of the deficiencies of a purely positivist approach. While empiricism will remain part of any practical research, it is important to both widen its scope to include the patterns of human cognition, feelings and values, and to disassociate this approach from the requirement to formulate universal laws.

Gestalt theory directs us to consider the 'overall' message of the map. This is amplified by post-modernist deconstruction, and structural marxist insight suggests historical materialist reasons for the existence and type of this message. Much will be made of this, though not uncritically, in attempting to understand the reasons why people claim to have difficulty in reading maps.

Phenomenological writing encourages us to conduct research in the context of the map user's lived world. Structuralist authors also voice a contextual encouragement, this time directed at the placement of the user in the correct social context. This sort of encouragement also reminds us that any research we conduct is non-neutral and suggests that far from being a hindrance this realisation forces us to consider the social and individual goals of our research.

Post-modernist interpreters offer us the important idea of a multiplicity of alternate visions, suggesting that map users may benefit from the opportunity to recombine elements to construct their own discourses. This idea forms the beginning of the reconstructive task of this thesis, which is central to addressing the third thesis goal, that of exploring alternative cartographic solutions.

Agendas

Various research agendas for the revision or remaking of mapping have been suggested by thoughtful commentators. Behaviouralists such as Janelle (1969) have sought to explore cartographic solutions to the problem of representing non-metric data. Davies (1985) suggests that the cartographic challenge is the mapping of such subjective data in a recognisably conventional form. Hägerstrand looks to represent spatial data without divorcing them from the time dimension; this can be construed as another challenge to cartography. To Harvey, the challenge is to reconstitute cartography in a non-positivist framework in order to serve the people's geography, entailing a rebuilding from 'the ground up.' Post-modernists wish to learn to read maps deconstructively, unlocking their authority and presenting the deconstituted elements to users to produce alternative visions of what the world might be.

These agendas are a clear legitimation of the present research. Though this thesis does not deliberately seek to fulfil any one of them alone, in examining the thesis issues it is expected that progress will be made towards a better understanding of what might be involved in an 'alternative cartographic formulation.'

Cautions

It is not expected that this thesis will produce a complete set of alternative cartographic principles. In the mind of the present author this work will have repaid the time invested in it if various forms of alternative representations find some use in practical situations. While not aspiring to the level of formal cartographic laws, the ideas behind these alternative representations will remain as guidelines for thinking, people-centred map construction and, hopefully, further research.

There is here a line to be trodden carefully between ideographic and nomothetic inquiry. The research must be careful not to evict human agency from human geography, yet must not ignore the social context of individual and corporate actions. This tension forms one of the most intriguing dilemmas facing the human geographer.

In no way does the emphasis on reformation and revolution within cartography imply a complete, uncritical casting aside of the knowledge and principles of historical and contemporary cartographic thought. It may well be, in fact, that some of these principles find a new lease of life in a new context.

The Self

The preceding review has served to define more clearly the choices facing this researcher as he selects a perspective from which to view the research issues. I could select one of the perspectives introduced in this chapter, uncomfortable as I am with each one of them, and use it to gain genuine and valuable insight into the topic under study. However, I would be aware of a basic dissatisfaction with the exercise, because none of them approximate the way in which I think about the world. I could combine elements of the various perspectives, but this attempt to rework radically different views into some sort of new framework would rightly be viewed as syncretic. The implication is that this thesis may have to adopt "a strategy of accepting theoretical difference and divergence... and live with the perhaps productive incompatibility" (Hirst, 1982; cited in Gregory, 1986: 466).

Accepting this in principle, I nevertheless am free (and, on the basis of the preceding discussion, am *required*) to articulate my own way of seeing things, using this as a base from which to explore the topic. This will be done mindful of the insights, agendas and cautions of different perspectives. What I believe, if left unstated, will undoubtedly still affect the direction, style and outcome of the research. Moreover, it is the context within which the research issues themselves were generated.

The perspective I have used to analyse maps and cartographic communication is made up of two related components. The first, and most fundamental, is a concept of the ubiquitous egocentric self. The second, interaction ritual, is a consequence of communication between egocentric selves. Together they provide a starting point for an understanding of what is actually happening when a person tries to use a map.

Egocentrism

Following Harrison and Livingstone, my first task is to identify the cosmology I hold. It is sufficient for the purposes of this thesis to identify this as an evangelical Christian faith. My fundamental belief about the nature of reality is that it is God-created and therefore, whether I wish it or not, my thinking is influenced by biblical notions.

The biblical explanation for the state of contemporary society is that of *the failure of individual and collective human responsibility*, this failure being called sin. Sin is the condition of situating the self (rather than God) at the centre of one's life (II Timothy 3:2):

> "Sin is not an arbitrary conception. It is the assertion of the selfish will against a paramount authority" (Wescott, 1855; cited in Wiley, vol. ii, 1940: 83),

and

> "Sin, then, is self-separation from God in the sense of decentralisation, the place which should be occupied by God being assumed by the self... everything either flows from the self or is directed to it" (Wiley, vol. ii, 1940: 84).

A modern synonym for this condition is *egocentrism*. Egocentrism is, in fact, a manifestation of what the Bible calls a sinful heart - a heart that loves self more than God or others. This sin manifests in society when the self seeks to expand the area of its influence, attempting to exercise illegitimate power over others. The egocentric self is *impositional* in nature.

Each self has physical and emotional requirements, such as food and love. These are not sinful, nor is it wrong to be concerned with provision for oneself. A large part of social interaction is designed to make the boundaries between oneself and others clear, so as to allow people opportunity to provide for themselves. Thus, many social rules are designed to *assert* the self, establishing individual rights.

Christian thought argues that the surrendering of the impositional self to Christ is essential. With Christ at the centre of the human soul, actions become motivated towards extending His kingdom rather than one's own. This is spelled out in Matthew 6:33: "Seek first the kingdom of God, and His righteousness, and all these things [the requirements of the self] shall be added unto you."

The Bible suggests that this egocentric condition is characteristic of humanity. Impositional activity exists at scales ranging from children on the playground to global processes and conflicts. The simple idea of egocentrism is therefore used to evaluate cartography. It is argued that impositional egocentrism, the attempt to impose one's own ideology on others, is the 'overall' text that can be read from the cartographic discourse. Maps are the products of institutionalised power structures which exist to advantage some selves over others. They should, however, exist to serve the needs of their users. It follows that, to remove imposition from cartography, maps should become the products of those who use them.

This thesis strives for an understanding of the impositional nature of the cartographic process that stresses the effects of both the workings of formal power structures and the existence of human free will. The solutions it offers seek a compromise between the imposition of rigid alternative cartographic laws and the chaos of uncontrolled individual cartographic representations. By removing the imposition of one self on another, this perspective allows the assertion of oneself. This self-assertion in cartography is what is referred to in this thesis as 'putting self on the map'.

Interaction Ritual

In 1955 Erving Goffman introduced a new analysis of social interaction based on a concept of *face.* He suggested that each participant in a social interaction claims a positive social value for him/herself by encouraging others to assume that he/she has acted out a small ritual - "a pattern of verbal and non-verbal acts" (Goffman, 1967: 5). For example, the ritual apology which everyone knows is insincere is nevertheless acceptable because it assists another person to save face. The act of apologising allows the apologiser to claim a positive social value, that of humility. Writers claim that such rituals are ubiquitous (with small cultural differences) among humankind (Brown and Levinson, 1987).

Such an analysis is clearly based on egocentric notions of the self. It is advanced here because *face-work,* the name given to interactions regarding face, projects the condition of egocentrism on to communicative situations, of which the map is a particularly ritualised example. Interactants have two specific types of *face needs* which they wish others to attribute to them: *negative face,* the desire to be unimpeded in one's own actions; and *positive face,* the desire to be approved of (Brown and Levinson, 1987). Politeness rituals such as honorifics, ceremonial gestures of submission and commands phrased as questions are all designed to feed the initiator's positive face (by gaining approval) and to avoid damaging the recipient's negative face. Negative face can be considered to be the assertion of oneself.

Cartography can be interpreted as an elaborate, if one-way, interaction ritual between egocentric selves. It is argued in subsequent chapters that the generators of map communication often seek to impose their ideology upon others, known in interaction ritual as a *face attack.* The use of maps for this purpose is so heavily disguised by the supply of supposedly objective information that it is impossible for the recipient, even if he or she recognises the attack on his or her negative face, to respond to it. The map generator can point to the facts and claim that he or she has been misinterpreted. Of course, the non-iterative nature of most map communication makes the possibility of such response remote in almost all circumstances. The feeling of helplessness this engenders may either be mistaken for a feeling of inadequacy or may lead to frustration with the medium.

The point of this discussion is that no theory of cartographic communication has considered the interaction of the map generator and the map user in such a manner. The idea that map generators have the power to extend the borders of their influence by conducting a sophisticated face attack on a large, generally defenceless population is substantiated when, as is done in this thesis, maps are deconstructed to reveal the motives of their makers. It proves to be a powerful idea in the quest to understand why many people feel alienated by the maps they have had to use.

Conclusion

The review of six perspectives which comment on cartographic theory provided a number of insights, agendas and cautions to the researcher. No one perspective proved satisfactory for the attainment of the three thesis goals, though each perspective has contributed towards an understanding of the present condition of cartography and possible scenarios for its reformulation. In the absence of a clear commitment to any one perspective, the author has chosen to advance his own perspective as a framework for inquiry.

Cartographic communication and its medium, the map, will be interpreted in the context of the rules of interaction ritual, driven by the needs of egocentric selves. This merely recognises that map users have needs for which they procure maps, and map generators have needs, to meet which they generate maps. The intersection of generator and user need is the location of this thesis. An understanding of what is happening at this location, and why it is happening, is essential if any of the three thesis goals are to be met. An interpretation of the *mechanics* of what happens in cartographic communication is the subject of the next chapter. Chapter Four proceeds to explain the *meaning* of such communication. Together they form part two of this thesis.

Chapter Three

A Critique of Cartographic Communication

Introduction

Part Two of this thesis investigates the first thesis goal: simply stated, "Why might people have difficulty interpreting maps?" This investigation is carried out with reference to the tension between human agency and social structure highlighted in Chapter Two. In this chapter and the next the face needs of individuals involved in the cartographic experience are seen to be mediated and inhibited by social structures themselves generated to advantage some 'selves' over others.

This chapter examines what writers have said about maps, specifically the matter of how map authors communicate with their audience through the map medium. The discussion in this chapter uncovers three fundamental deficiencies in popularly held theories of cartographic communication. Possible solutions to these three problems are used to construct a new model of the *mechanics* of cartographic communication. The following chapter will examine more specifically a particular linguistic theory of communication to explore how people gain meaning from communication.

The Provision and Utilisation of Cartographic Information

Maps serve a communicative function. The map's primary purpose is to "get across" a concept or relationship (Robinson, 1960). This function by no means exhausts the utility of the map. Maps may also serve as devices for the storage and/or analysis of spatial information (Campbell, 1984). However, the central issue with which this thesis is concerned involves the communication of information or, more correctly, the transfer of meaning (Fabun, 1968).

The discussion in Chapter One asserts that at least some people have difficulty in interpreting maps. Cartographers are without exception keenly aware of potential and actual misunderstanding of maps. Keates says that "most map users will admit that on occasions they have found maps to be unsatisfactory" (Keates, 1982: 1). Another cartographer writes "After more than twenty years of experience in teaching undergraduates, I am fully aware of the difficulties which confront the uninitiated in map interpretation" (Dury, 1960: v).

Three basic reasons for imperfect map communication can be distilled from cartographic literature. The first involves *map users blaming map makers* for producing imperfect maps. W.G.V. Balchin's 'Media Map Watch' spent much time and effort identifying British maps that did not conform to supposed 'norms' of cartographic construction. This idea arose "in the Geographical Association during 1984 as a result of discussion prompted by serious defects of map representation in certain TV programmes" (Balchin, 1985: 339). Keates says that "in virtually all cases [of misinterpretation] the map (or the map maker) will be blamed, rather than their own incompetence, wrong judgment, or lack of skill" (Keates, 1982: 1).

The second reason for imperfect map communication is advanced by cartographic writers. Many of these writers, without even a cursory investigation of their thesis, argue that a fundamental *inadequacy of map-reading skills among map users* is the main reason for problems with map interpretation. This seems perfectly reasonable at first sight: map makers are obviously satisfied with their product, so if problems arise it must be because map users cannot use that product correctly. Without paying closer attention to the adequacy of this argument, many cartographic researchers have invested their working lives in studying aspects of the makeup of the map user for clues as to where the failings lie. Perception studies, analyses of cognitive skills and memory recall, and work with children studying the development and retardation of graphicacy are examples of this work. Debates have centred on the extent to which map reading skills are learned rather than innate (Blaut *et al*, 1970), and the popular press has sold copy by highlighting the seemingly universal lack of simple locational knowledge in many different countries, writing headlines like "59% of Iowans could not correctly locate Chicago on a map of the USA!". All of this adds up, according to many writers, to an appalling lack of basic map-reading and retention skills in the general populace. Behind much of this writing one can discern a faint ridicule of the map user. This attitude, unfortunate in itself, also betrays a lack of self-criticism that has hindered the development of a truly relevant cartographic theory.

Thirdly, map users can be frustrated in their attempts to procure mapped information. Parry and Perkins introduce an index of world maps by saying:

> "You need a map? How do you know whether it's published, suitable, available, acquirable? Those who deal with cartographic information know the inherent difficulties of these questions, although they will certainly also know how to begin the long-winded process of finding out. Those who are not familiar with maps will probably not know, and may rapidly give up trying" (Parry and Perkins, 1989: 1).

Keates represents these barriers to information diagrammatically as shown in Figure 3.1. His analysis shows that problems associated with user misinterpretation are but a small segment of a total set of permutations in the provision and utilisation of cartographic information. The third reason for imperfect map communication is, therefore, a *problem of user accessibility to the right map.*

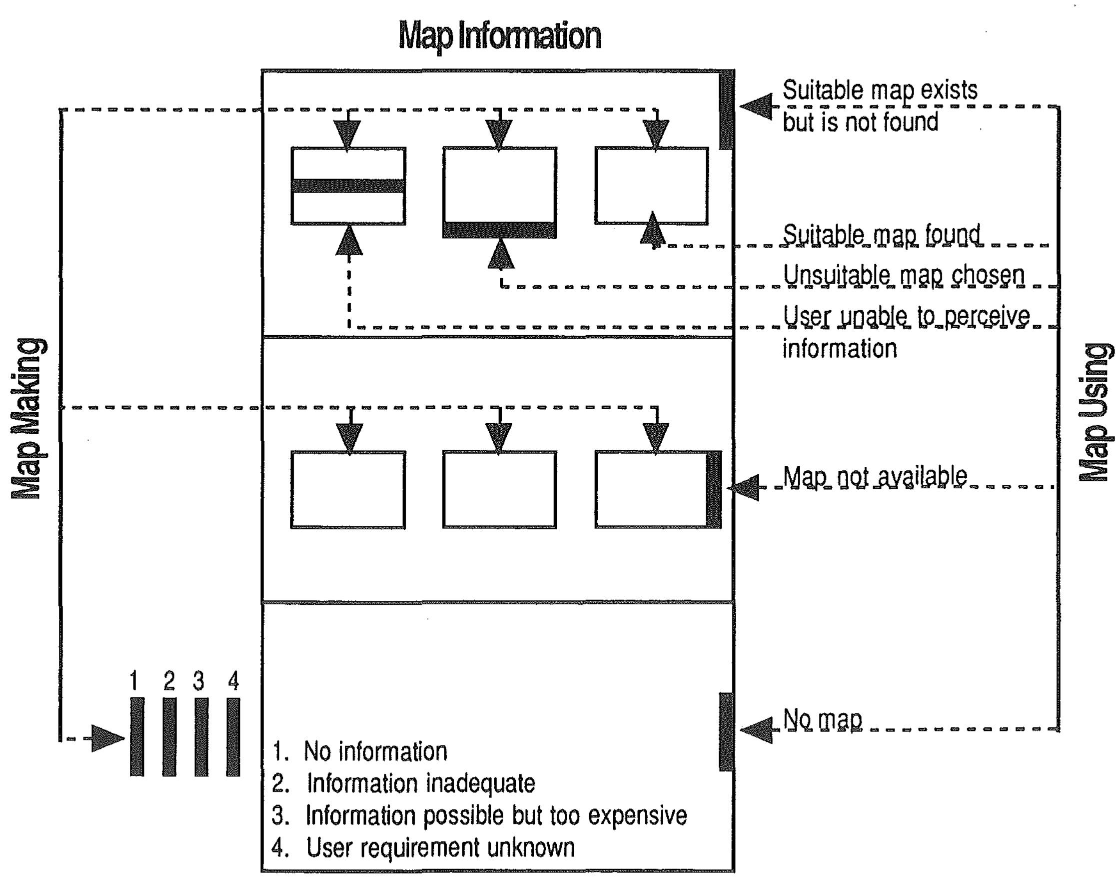


Figure 3.1. Informational barriers in map making and map using. Source: after Keates, 1982.

Most cartographic research has focused on uncovering problems of map interpretation, focusing on the perceived inadequacies of the map user. Another body of literature, consisting mainly of bibliographic publications, attempts to address problems of user accessibility. Very little research has focused on the inadequacies in the provision and construction of maps. Indeed, this focus on user inadequacy has misinformed cartographic research to the point that it is self-defeating. A critical review of the two main theories of cartographic communication will now be presented, to both demonstrate the fundamental problems with current analyses and to indicate areas for a more fruitful inquiry.

Theory 1, The Process Model.

In its simplest form the Process model of communication can be represented as in Figure 3.2. A number of basic points relating to any sort of communication are made clear by this diagram. First, communication requires at least two participants, a *sender* and a *receiver*. An unheard soliloquy is not communication. Secondly, the communication itself (the *signal*) is separate from both the sender and receiver. Thirdly, every communication requires a medium through which to *transmit* the signal. This might be the air waves (in the case of verbal communication) or the printed page (as in the case of written communication). The main strength of the Process model is the way in which it highlights these basic components of communication.

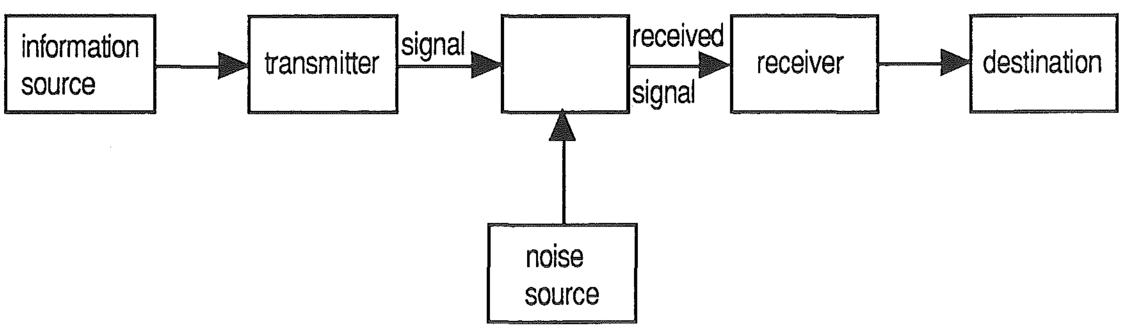


Figure 3.2. The Process model of communication. Source: after Fiske, 1982.

Although the idea of communication as transmission of information from one person to another has been overtly stated at least since Aristotle (Fiske, 1982), Shannon and Weaver gained wide acceptance for their model because of the analogy it employs, comparing the communicative act to the electronic transmission and reception of data. Their work was conducted at Bell Telephone laboratories during the Second World War with the purpose of maximising the efficient transmission of information through electronic channels of communication, thus aiding the war effort. The theory they developed enabled them to estimate the information capacity of any electronic communication channel. Important both to this review and to the academic conception of cartographic communication in general is their assertion that the 'Mathematical Theory of Communication' (as they called it) can be applied to any form of communication (Fiske, 1982).

At the time that this work was published cartographic practise was undergoing a major transition from 'art' to 'science'. The need of a post-war society for hard data to assist in rebuilding and restructuring, and the related shortage of and competition for finance, led many in the discipline to revise their interest in cartographic theory from a concern for the components of the map to one for the development of an overall theory of cartographic communication. This focus, they hoped, would enable cartographers to measure the effectiveness of any given map and achieve the related goals of enhancing cartography's scientific prestige and attracting finance. Shannon and Weaver's work was first adopted and later adapted by eager cartographic researchers (Moles, 1964; Board, 1967; Kolacny, 1968; Ratajsky, 1973; Jolliffe, 1974) who designed derivative models, some of which are among the most well-known and often-reprinted in cartographic literature.

Shannon and Weaver suggested that their model could address three problems in the study of communication. These are:

1). Technical problem: How accurately can the symbols of communication be transmitted?

2). Semantic problem: How precisely do the transmitted symbols convey the desired meaning?

3). Effectiveness problem: How effectively does the received meaning affect conduct in the desired way?

In exploring the mechanisms of cartographic communication, scholars have placed almost all research emphasis on the first problem, showing lack of interest in the second and third. In this they followed Shannon and Weaver whose work was also concentrated on the first problem (Fiske, 1982). For those scholars basing their work on Shannon and Weaver's model,

> "Cartography was concerned with the *transmission* of messages from the cartographer about reality to a receiver (the map percipient or

> observer) by means of a channel of transmission, that is, the map" (Scott, 1986: 7. emphasis mine).

The map was analogous to a coded message, put together or *encoded* by the cartographer in the map making process and *decoded* by the map user in the process of map reading. 'Interference' to the perfect communication of the message of the map maker was known as *noise* (analogous to the crackling sound in a telephone wire). Later theorists divided 'noise' in to many types, such as 'designer noise', in which cartographic choice obscured the message, and 'reader noise', encompassing unexpected psychological reactions to the map (Board, 1967).

The Process model can be criticised in four main areas:

1). The incompatibility of the electronic communication analogy to the actual act of communication.

2). Its failure to grapple with the complexity of real-world communication.

3). The concept of 'noise'.

4). Its linear nature.

Firstly, it can be shown that electronic communication is not analogous to the communicative act. Although it provides elements necessary for communication (sender, message, medium and receiver), these alone are insufficient for communication to take place:

> "If a person speaks gibberish into a telephone, and it is clearly audible to a listener, then the communication system is working perfectly well. It is, however, questionable whether any 'communication' has taken place" (Keates, 1982: 97).

Shannon and Weaver's work analysed the communication system rather than communication itself. Their model, and those derived from it, do not show how meaning is generated or interpreted.

Secondly, cartographers have advanced the Process model and its derivatives *a priori* without testing it with reference to actual maps. This means that the question of whether the model accurately reflects the origin, production and use of particular maps is not answered.

Any test would be rendered meaningless by the third difficulty with the Process model: the concept of 'noise'. Noise is, literally in some cases, portrayed as a 'black box' into which all communicative and interpretative problems are conveniently placed. This practise helps reveal neither the origin nor the solution to problems with cartographic communication. While noise makes it harder to hear what the communicator has said in electronic communication, in real-world communicative interchanges the audience may hear perfectly well but misunderstand. Properly, noise can only be assigned to the *channel* of communication. Something else happens at the beginning or end of the communicative act to cause misinterpretation, but it cannot correctly be called 'noise' and still maintain the electronic analogy.

Finally, the linear nature of the Process model is seen by critics as a rigid and mechanistic view of communication. Fisher, describing the Process model as a 'mechanistic closed system', writes:

> "It takes little imagination to realise mechanism's profound appeal to the practising scientist. If prediction is a desirable goal of scientific enquiry... then conceptualising the observed system as closed and therefore deterministic is a natural theoretical perspective for the conducting of empirical research" (Fisher, 1978: 101).

The one-way, closed system idea promoted by the Process model means in practise that the map is seen as a method of sending information to a passive map user. Keates sums up the comments of many writers who have argued that the audience to a communication cannot be passive by saying:

> "If there is one point on which all the authorities are united - philosophers, psychologists and physiologists - it is that the human percipient is not a passive receiver of messages" (Keates, 1982: 98).

Instead,

> "The receiver is, more often than not, also an initiator, both in the sense of originating messages in return, and in the sense of initiating processes of interpretation" (McQuail, 1975: 17).

This final criticism of the Process model has introduced the idea, crucial to this thesis, of iterative or two-way communication. It will be discussed later in the chapter, and will form a focus of empirical work presented in Chapter Nine.

The Process model attempts to use an outline of the mechanics of communication to provide insight into the way in which meaning is communicated, and fails. A different approach is employed by the second major theory of cartographic communication.

Theory 2, Semiotics.

In its simplest formulation semiotics is the study of signs and the way they signify thoughts. The three areas of study specifically addressed by semiotic researchers are:

1). The signs themselves, from which messages are constructed;

2). The codes by which these signs are constructed and interpreted; and

3). The culture within which these signs and codes operate.

Communication, its proponents argue, takes place when a communicator constructs a message out of signs and passes it on using a 'sign vehicle' to an audience, which is encouraged to create meaning from this collection of signs based on its understanding of the code. The more congruent the codes of communicator and audience the more closely the two meanings of the message will approximate.

John Locke coined the term 'semiotics' to describe the study of signs. This study was formalised in the early twentieth century by the independent work of Sausuerre and Peirce, writing as linguistic theorists, from where it has spread to include an analysis of visual communication (Fiske, 1982). Cartographers began to embrace semiotics at about the same time as it fell from favour with linguists.

Its attractiveness to cartographers includes its theoretical emphasis on meaning and context (two weaknesses of the Process model) and the apparent suitability of a sign-based model to a method of communication involving literal symbols. The essential elements of the semiotic model are represented diagrammatically by Keates, here reproduced as Figure 3.3.

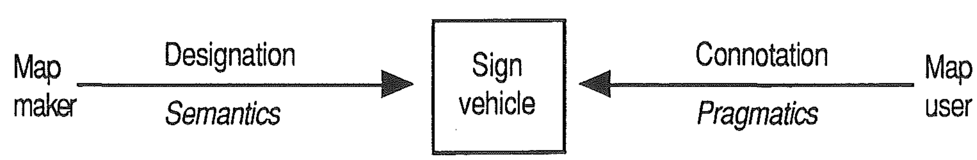


Figure 3.3. The elements of a sign system. Source: after Keates, 1982.

It is important to note that this is not a linear system or a 'process'. The central focus is on the sign vehicle (the map, in this case), which is approached differently by map maker and map user. The map maker constructs the sign vehicle according to rules of *semantics*, the common meaning of signs, while the map user interprets this sign vehicle in terms of *pragmatics*, which in this context means the relationship between sign and interpreter (Morris, 1938). Another way of explaining this, favoured by many semioticians, is that interpretation is a matter of what *connotation* the interpreter places on the *designation* of the communicator.

A strength of this theoretical construct is that it moves away from a focus on the mechanics of the communication system to a concern with the encoding and decoding of concepts. Another advantage of conceiving of communication in this manner is the recognition that the map user has an active part to play in the interpretative process. Thirdly, it provides an obvious focus for identifying sources of misunderstanding: the meaning denoted by the sign may not have that connotation for the user. The map 'works' when maker and user come into agreement on the meaning of each sign and the relationship between the sign (*syntactics*). If that agreement is not forthcoming, perfect communication has not taken place:

> "A sign system only functions because the creator and the user attempt to agree on the meanings of the signs and their relationships. Whether this can be fully accomplished in any sign system is debatable, but a great deal of education is directed towards the goal of ensuring that signs are correctly interpreted and understood" (Keates, 1982: 65).

Keates' words provide a starting point for criticism of semiotics as applied to cartographic communication. The implication contained in the latter half of his statement is that education is required to ensure the correct functioning of the sign system, and that this education must be directed at the interpreter of signs - the map user. Keates slips into the simplistic suggestion that the blame for imperfect communication lies with the audience to that communication. There is no mention of directing effort towards ensuring that signs are correctly drawn and presented.

The mounting criticism of semiotics as a system for understanding is based on its failure to explain even one real-world example of how meaning is generated, transferred and recovered. Semiotics is seen as an unproductive framework for research: "the recent history of semiotics has been one of simultaneous institutional success and intellectual bankruptcy" (Sperber and Wilson, 1986: 7).

Semiotics has been the reigning paradigm for decades in many disciplines concerned with communication, but is now being rejected for the following reason. While accepting that one way of characterising any language is as a code made up of signs (as a map is a code made up of signs), it can be shown that the signs themselves do not contain meaning. The partial overlap of 'meanings' between communicator and audience is a long way from the perfect intersection of meaning required to interpret correctly a sign and supposedly guaranteed by the use of the same code. "Its main defect", argue Sperber and Wilson, "is that it is descriptively inadequate: comprehension involves more than the decoding of a linguistic signal" (Sperber and Wilson, 1986: 6). Nothing within the semiotic system explains how two people viewing the same sign and aware of the same codes might interpret that sign in different ways. It is evident that this does happen, for when cartographic researchers test symbol recognition, a subject in one test might identify a symbol as meaning one thing, yet in the same test a month later might identify the same symbol in the same context as meaning quite another thing:

> "The vast majority of perception studies are of limited consequence to cartography... because the variance in the responses, even when collected over a short time period and from supposedly homogeneous groups, is often considerable" (Rhind, 1980: 30).

There is obviously at least one hidden aspect of comprehension not uncovered by semiotics, and this makes semiotics less useful for the assessment of real-world interpretative problems, as many cartographic researchers have found out to their despair (Castner, 1988: *pers. comm.*).

The basic problem is not really with semiotics at all. It is with those who insist on making it do more than it can do. Semiotics is a model of how some aspects of communication work, but it does not show how meaning is evoked. It is a theory of signs, not theory of people. It cannot explain, and does not allow for, the vagaries of the human mind.

The use of the Process and Semiotic models of cartographic communication has seriously sidetracked cartographic research. Instead of facing frankly the possibility, intuitively known but seldom admitted, that misinterpretation can arise just as easily from the inadequacies of the communicator as from the lack of education of the audience, the work has focused on the map user in an attempt to understand his or her foibles. This focus has given us, for example, studies which purport to show how map users 'systematically distort reality' (see Chapter Two), as though the map maker is in a privileged position of seeing and presenting an undistorted reality to the map user. A more realistic picture is, of course, that cartographers 'systematically distort' what they see both in the act of seeing and in the need to represent multi-dimensional reality on two dimensions, which is then further 'distorted' by map users. While not entirely accurate, this picture at least demonstrates the extent to which cartographic writing misses the mark.

Aware that presently available models of cartographic communication do not adequately describe real-world experience, and despairing of them to do so, cartographic theorists write pessimistically (if honestly) in the vein of Keates:

> "... generally speaking the supporting evidence for the general theories advanced is lacking. A critical review leads to the conclusion that at present any such general theory is a long way from realisation" (Keates, 1982: x).

Fundamental Problems with Cartographic Communication Theory

The most promising avenue of inquiry is not to focus on what each theory has done inadequately, but rather to address issues left untouched by these theories. It is argued that all previously proposed models of cartographic communication are fundamentally inadequate in three respects.

1). How and why map messages are generated has not been addressed.

2). How the message is formed and reformed is dealt with inadequately if at all.

3). How the message is received and interpreted is misunderstood.

Discussion of these three inadequacies follows.

1. Map Generation, The 'Myth of Cartographer Centrality'.

Not unnaturally, those who write about communication are generally themselves accomplished communicators. They are accustomed to seeing themselves at the centre of the communication process. In the case of mapping it is academic cartographers who are overwhelmingly represented in cartographic literature, cartographers who are generally free to decide what to map and how to map it. *Their projection of their own centrality in the mapping process on to cartographers in general is the 'Myth of Cartographer Centrality'.* They fail to recognise that theirs is an exceptional situation in the cartographic world, where typically the working cartographer does not have the freedom to decide what to map. The perpetuation of this myth has led to the cartographer being represented as map generator in models of cartographic communication.

One does not have to read far for evidence of this myth:

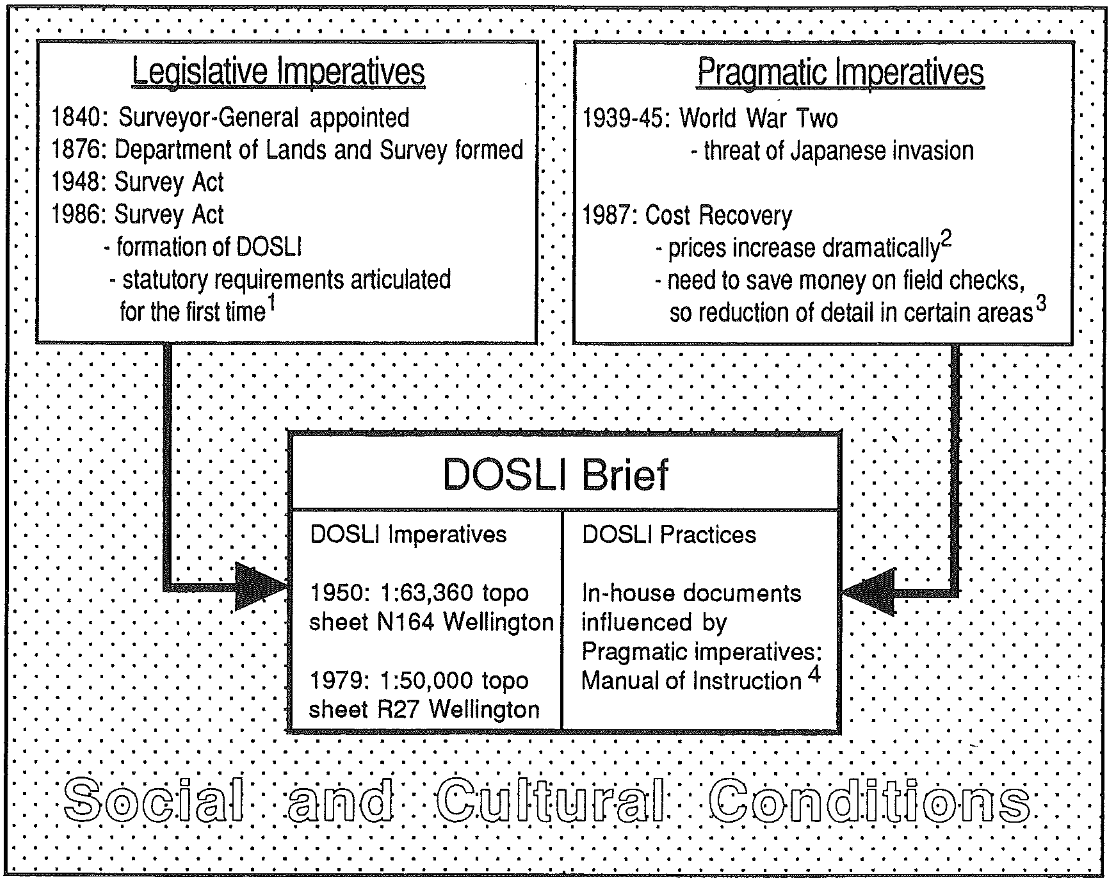
> "According to Kolacny the process starts with the cartographer's selective observation of reality; according to Ratajsky the cartographer becomes acquainted with reality; according to Morrison (1976: 89) the starting point is "... the cartographer's desire to communicate a portion of his cognitive realm to someone else." Despite the variations in expression, the impression is given of a personal or individual cartographer who wishes to make a map for some purpose known to him, with the object of communicating this information to one or more users" (Keates, 1982: 101).

Keates acknowledges that cartographers generally do not initiate the mapping process: "... it becomes clear that in most cases the map is not initiated by a 'cartographer' at all" (Keates, 1982: 101).

The impression of cartographers' centrality is manifestly insufficient to explain the complex relationships of map initiation for maps produced by private business and government agencies. In these cases the cartographer merely mediates the wishes of another, having little say as to what is mapped, why it is mapped and even how it is mapped. To illustrate this point, the genesis of one particular map, NZMS 260 1:50,000 Topographic series Sheet R27 Wellington, is portrayed in Figure 3.4. The multiplicity of factors involved in the generation of sheet R27, including the statutory responsibilities of the Department of Survey and Land Information (DOSLI), the requirement to produce and maintain a topographic survey, the interpretation of these by the administration of DOSLI, the weight of precedent as to how these maps ought to be produced, the primacy of surveyors over cartographers, and the automation of much of the cartographic process, clearly contrast with the simple act of map making academic writers seem to be thinking about as they write. Above all else, sheet R27 is a document initiated by a combination of historical precedents and events mediated by individual decision-makers far removed from working cartographers. This is made clear by Figure 3.5, which shows the historical iterations in the generation of sheet R27. It has a historical inertia very difficult for a cartographer to influence, let alone halt.

If working cartographers do not initiate such maps, who or what does? The answer to this question is central to this thesis.

A broad spectrum of entities have the potential to initiate the production of a map. At one extreme of the spectrum is the individual who sketches a crude schematic diagram to aid a tourist find her hotel. At the other extreme is the sort of organisation mentioned above, responsible for the production of a government's mapping requirements. Between these two extremes are individuals, groups and institutions all wanting to communicate spatial information to meet their own needs or the perceived needs of others.



1 "To ensure the provision of topographic... data bases to adequate standards for the efficient administration, enjoyment and development of the resources of New Zealand." Survey Act, 1986.

2 Since 1987, when the cost was $2 per sheet, the increase is in the order of 500%.

3 For example, the classification of bridges is now no longer shown (Concrete, Suspension, Wooden etc.).

4. This manual lists that which is required to be mapped on the 1:50,000 series, and the way in which it is to be mapped. It is produced in consultation with the Ministry of Defence and used by DOSLI cartographers.

Figure 3.4. The genesis of NZMS 260 1:50,000 Topographic Series sheet R27 Wellington.

It is at this point that fruit is borne from previous discussions about the relationship between human agency and social structure. Within even the largest organisations are to be found individuals and groups with the right to authorise or to veto the production of a map. When considering the generation of maps, the largest institution can be narrowed down to those key agents. However, no agent operates independently of the social structure in which his or her authority is embedded. As in the example of sheet R27 above, a weight of legal and pragmatic imperatives constrain the actions of such authorised agents. These legal and pragmatic imperatives are historical events that have set a precedent for the type of maps to be produced, and changes need to be weighed against this precedent. They are themselves responses to social conditions and objectives. Money-making, defence, resource development and social order are all powerful social reasons for the production of maps, and are discussed more fully in Chapters Five and Six.

Maps are, therefore, generated by the interaction of individual or group goals, constrained by historical precedent and embedded in a social context.

Map generation is depicted in Figure 3.6, where three possible outcomes can be identified when any individual or group needs to communicate a message, and has the means to do it:

1). No communication. It is decided not to produce the message in any form.

2). A Map Idea. It is decided that a map is the best form of communication, so the idea is forwarded to a map maker.

3). Use of another communications medium. It is decided that a another medium is the best form of communication.

Although generation of even the simplest of maps takes place in a social context, individuals clearly make the decision to proceed with the making of a map. It is this individual or group of people whom this thesis identifies as map generators.

Map Generators are those persons or groups of people who are authorised to initiate the production of a map.

A clear distinction can usefully be made between map generators and map makers. The example of the genesis of sheet R27 indicates the existence of complex relationships between factors giving impetus to the production of this map and factors involved in facilitating this production. Having something to communicate, the map generator is responsible for the *articulation* of the map message, while map makers are instrumental in its *communication,* acting as facilitators rather than initiators.

Including map generation as an initiatory element in either of the two models of cartographic communication reviewed thus far improves their explanatory power immensely, allowing them to more closely approximate the real-world situation. The next chapter will examine the role of map generation in determining both the subject matter and the form of maps.

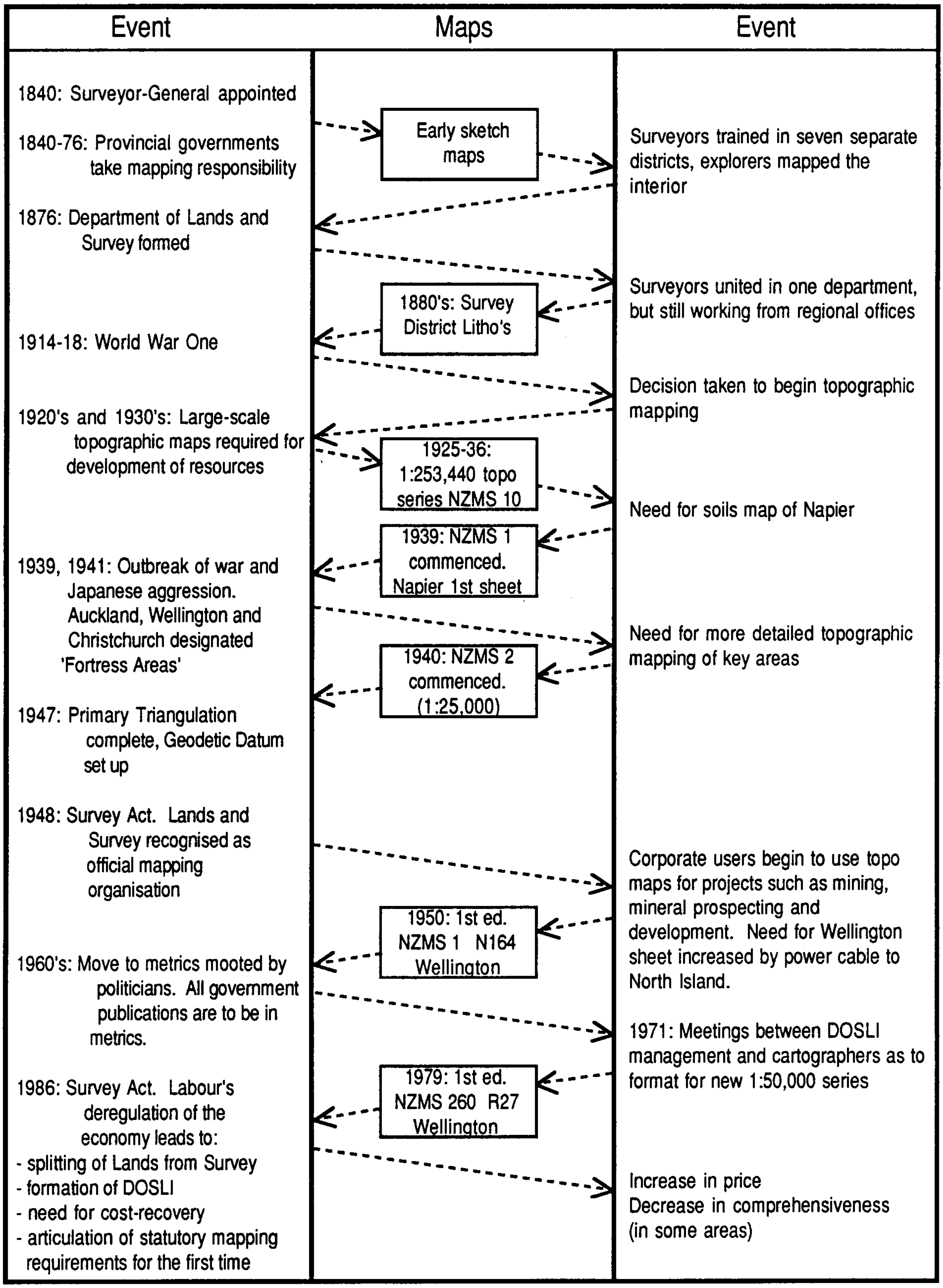


Figure 3.5. Historical events in the generation of NZMS 260 1:50,000 Series sheet R27 Wellington.

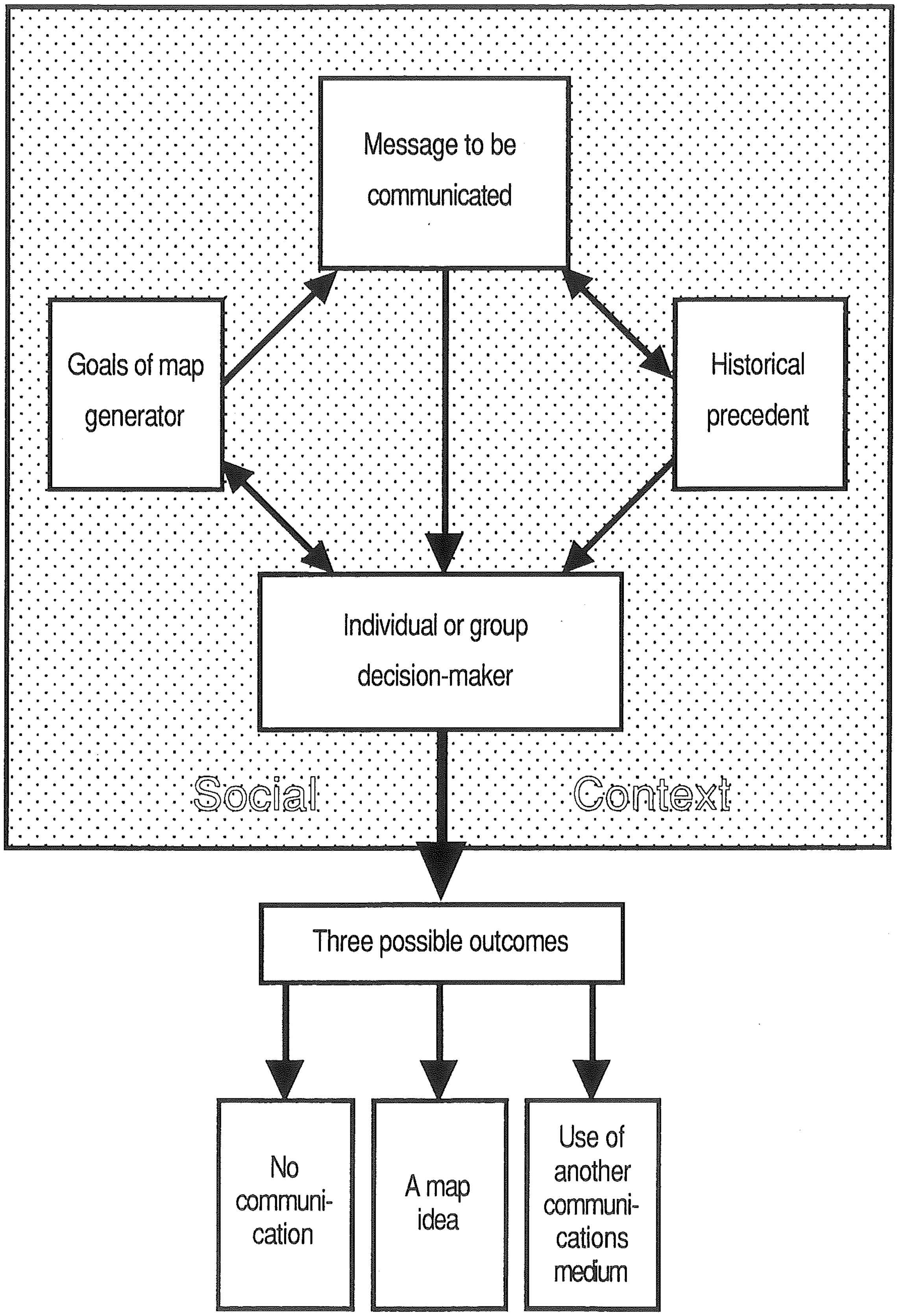


Figure 3.6. Map generation.

Misrepresentation of cartographers as the initiators rather than the mediators of the cartographic message has important consequences for the integrity of that message. Cartographers are often charged with the need to be objective and impartial in their work, supporting no one view over another: for example, scientific integrity is said to be the fundamental quality needed by mapmakers (Wright, 1942). In a paper reporting on the excesses of 'propaganda' mapping, Murray says that "... most cartographers *select* material which produces an objective treatment of *their* subject" (Murray, 1987: 238, emphasis mine). While the implication of this is that the message as well as the method will be objective and dispassionate, the exposure of the myth of cartographer's centrality indicates the problematic nature of the words highlighted in Murray's statement. Because it is not *their* chosen subject, cartographers are in no position to *select* material. Even were they in this position, their treatment of the subject could not hope to be objective, uncoloured by the inherent bias of the message they are commissioned to communicate. No matter how objective map makers wish to be, the material they are required to work with may well be less than objective.

The identification of the myth of cartographic centrality has allowed the introduction of the map generator as the initiator of cartographic communication. Further implications of this important advance in understanding will be discussed when the revised model of cartographic communication is presented.

2. Map Making, The Deconstitution and Reconstitution of Reality

The identification of map generators rather than map makers as initiators, allows further improvement to be applied to models of cartographic communication. At present map makers are conceptually separated from the map, with the map regarded as the communication and the map makers as the communicators. Now that map makers are no longer seen in this light, the artificial separation of mediator and medium can be removed. Cartographers need to be considered in the same context as the production, not the initiation, of the map.

Map makers have been commissioned to make communicable sense out of reality. More accurately, they deal with that subset of a complex spatial reality defined as the 'message' or 'topic' or 'area' they have been assigned to represent. To do this they first *deconstitute* that aspect of reality under study into a set of data with locational attributes, then *reconstitute* these data into cartographic elements which are combined as a map for the purposes of communication. There are therefore two parts to any map making endeavour: deconstitution and reconstitution.

This simple distinction is central to understanding the various roles of the map maker in mediating the communicative intent of the map generator. It is quite unlike that suggested by any code model, where the cartographer is said to 'encode' the message. The activities of deconstitution and reconstitution correspond roughly to *map subject matter* and *map form,* another way of looking at the map itself. Once a subject for communication is generated, deconstitution is concerned with isolating the 'matter' relevant to that subject. *The deconstituters mediate the subject matter of the map.* When this 'matter' is isolated, reconstitution is concerned with assembling it into a particular map form, usually assigned as part of the Generator Brief. *The reconstituters mediate the form of the map.*

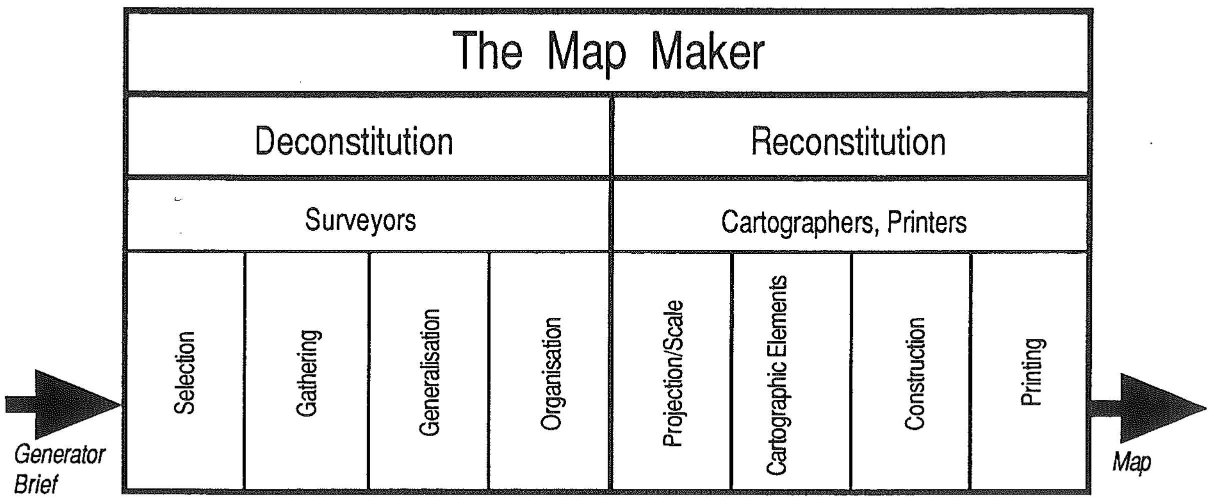


Figure 3.7. The work of the map maker: Deconstitution and Reconstitution.

Figure 3.7 is a representation of the process of deconstitution and reconstitution as applied to a complex map such as sheet R27. Naturally, a simple sketch map contains fewer of these elements. Cartographers have identified the major acts of deconstitution following the selection of a topic: the *selection* of appropriate data; the generally expensive and skillful work of *gathering* that data; the *generalisation* of that data, eliminating that which cannot be mapped at the scale chosen; and the *organisation* of the data, working it into a matrix amenable to mapping. At the end of these processes there is no identifiable cartographic product. What has been produced is a database from which a map can be reconstructed.

Reconstitution begins with the choice of the appropriate projection and scale for the map. This is often a function of the Generator Brief and may not be up for negotiation, but these factors must be at least confirmed by the reconstituter. The other elements of cartography, such as typography, symbol choice, colour etc. are generally governed by traditional usage but are amenable to reworking by the cartographer. Finally the work of the cartographer is produced as hard copy through the work of the printer, who will have been consulted with regard to cost and feasibility at each stage of the production process. At the end of this process a cartographic product will exist, unless at any stage the generator rules otherwise.

The process of reconstitution is the heart of map making, yet cannot exist independently of the deconstitution process. Obviously, what is done by deconstituters has a determining influence on what is reconstituted and the form it will take. This is to say that map subject matter influences map form.

Although the reading of this discussion seems to trivialise the cartographer's activity to that of another instrument, this impression was inevitable given the inflated position given them in traditional academic analyses. The following three points should be noted:

1). Many generators of official maps are themselves former deconstituters (surveyors) or reconstituters (cartographers).

2). The map is still central to cartographic communication.

3). Many of the fundamental considerations in the generation of maps, including aspects of the structure of western society, have been influenced by the role of surveyors and map makers in exploration and colonisation (see Chapter Five).

These factors ensure that, while the cartographer typically does not exercise complete control over the subject matter and form of maps, cartographic considerations are central to map communication. The salient point in the overall discussion of cartographic communication is that, in the case of larger-scale mapping endeavours, these considerations are set in legislation and precedent and not as amenable to alteration as academic analyses intimate. It is only for the smaller projects or individual maps that notions of cartographic centrality have any meaning, and then only because the individual is often generator, maker and user.

3. Map Users, The Targeted and Non-targeted User

At the beginning of this chapter three possible reasons for imperfect map communication were identified. Map makers point the finger at map users, map users blame map makers and sometimes cannot even procure the maps they wish for. The application of principles already identified in the previous two sections allows the uncovering of a more plausible reason for user misunderstanding, as map users can be divided into two groups: *targeted* and *non-targeted*. It is argued that non-targeted users are much less likely than targeted users to recover the intended meaning from the map.

Any message has a target audience. While it may be possible for a message to be universally apprehended, most messages are designed to be particularly relevant to those who have requested its content. Given the concept of map generator as initiator of the map message, it is likely that map generators have a target audience in mind.

For example, a specific historical target audience can be discerned for sheet R27, for whom the subject matter and form of the map is designed. "By 1931... [New Zealand] had very few topographic maps; most topographic maps were of military manoeuvre areas" (Larsgaard, 1978: 80-81). The advent of World War Two gave impetus to the production of topographic maps in New Zealand, the first edition of the 1:63,360 map of Wellington (since superseded by R27) being produced in 1950. The intended audience for the information on this map was the military, who had in consultation with the government declared the area around Wellington a 'Fortress Area' designed to bear the brunt of any Japanese invasion, and who needed the detailed topographic information relevant to the defence against the perceived threat. The maps themselves were first produced using photogrammetry at a scale of 1:25,000, and after the war were combined "to produce the first photogrammetrically-derived 1 inch to 1 mile sheets" (New Zealand Yearbook, 1990: 408). Chapter Five explores the military origins of much topographic mapping, but at present it is sufficient to identify the Ministry of Defence as the initial target audience to the message of the map generator.

The recent history of topographic maps in general is the attempt by map marketers to widen the target audience. Map marketers can be seen as the intermediaries between map makers and map users, alerting map users to the available products and map makers of user wishes. Where they exist, they attempt to solve the third identified problem of imperfect communication, that of access. Recently, central government has required all of its departments to make some movement towards cost recovery. This means that topographic maps, which were generally sold at a fraction of their production cost, have to be more aggressively marketed to counteract the massive price rises necessitated by cost-recovery imperatives. The difficulty these marketers and DOSLI itself faces is that, to a large extent, the original form and subject matter of the maps they produce (R27 being an example) are still determined by a Generator Brief based on historical conditions which are relevant to only a small part of the intended market.

This wider target audience of people such as hunters and trampers (Aitken *et al*, 1985), and the non-targeted users who still do not receive notification of DOSLI products, are in a position analogous to the overhearers or 'eavesdroppers' of a conversation not meant for them. Even if they find the map useful for their own purposes, there exists the possibility that the original message of the map may obscure or omit what is to them important detail or detract from their needs. In the same way that an eavesdropper cannot be sure of the import of a conversation, non-targeted users may also miss out on visual information vital to understanding the map. This point is particularly important with regard to our topographic map example, for these maps are regarded as 'reference' or 'general' maps, as though they might have something to say on a subset of every topic. Clearly, no map can do this, and topographic maps are somewhat less than 'general' in scope. The non-targeted user may miss what is relevant to her or him either because it is not there or because they miss the clues provided by the generator to targeted users.

This *principle of eavesdropping* is shown in Figure 3.8, where U1 is the targeted user and U2 the non-targeted user. The diagram illustrates another important point: while the map generator and map maker supply the targeted users with the map, the non-targeted users must seek it out for themselves. They are, with reference to Keates' work, facing a greater information barrier even before they have the map in their hands. The further implications of this principle will be reviewed after the discussion found in the next chapter of this thesis.

The three fundamental problems with cartographic communication theory need to be considered when attempting to model the mechanics of cartographic communication. This is the focus of the final section of this chapter.

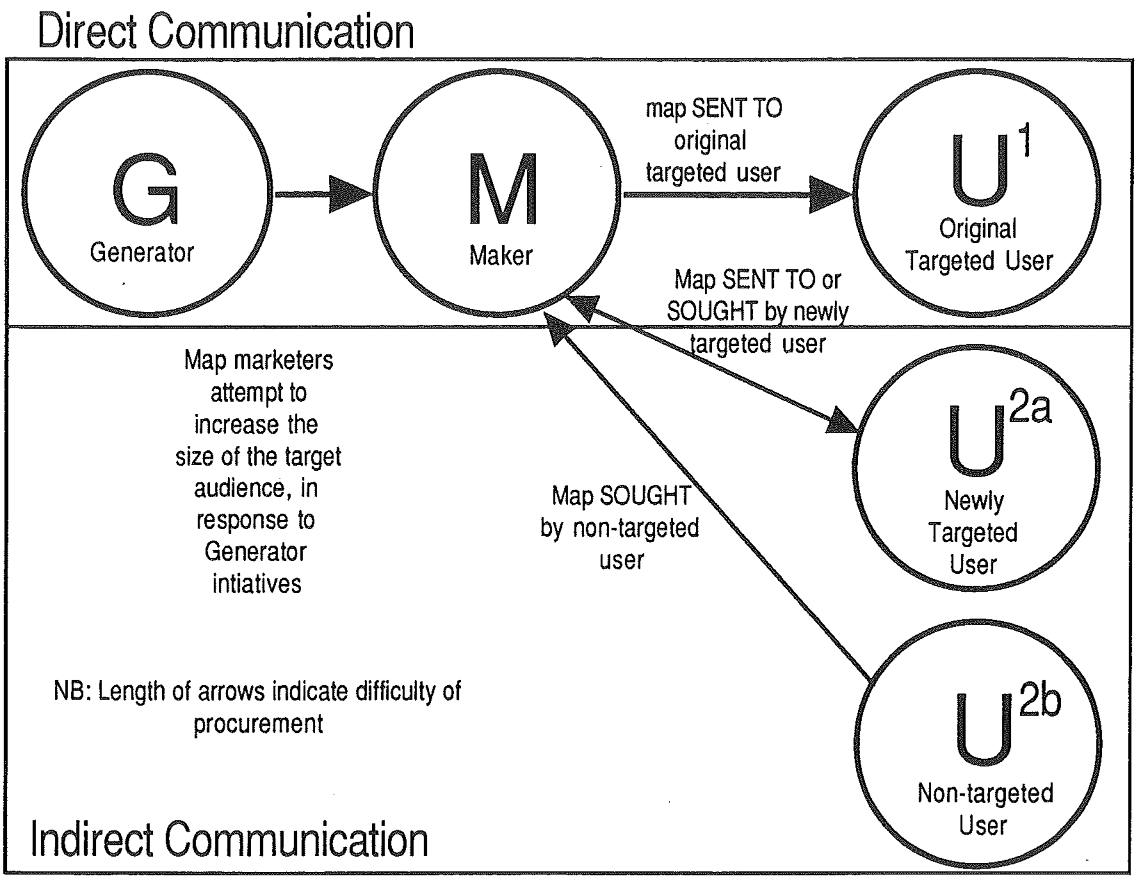


Figure 3.8. The principle of eavesdropping.

The MUGs Model

The previous discussion has introduced three major contributions to a realistic theory of the mechanics of cartographic communication. These are:

1). The initiatory and regulatory role of the map generator.

2). The recognition of the map makers' role as the deconstituter and reconstituter of that aspect of reality defined by the map generator.

3). The division of users into targeted and non-targeted groups and the introduction of the principle of eavesdropping.

The interaction of these factors is as important as the existence of the factors themselves and will be illustrated with historical and contemporary examples in Chapters Five and Six. It remains to conclude this chapter by demonstrating how these three factors might be integrated into a more satisfactory model of the mechanics of cartographic communication.

The model presented as Figure 3.9 is of the author's own construction. It should be visualised as consisting of three interactive layers. The first layer is made up of these three groups of people, the players directly involved in the production and consumption of the map product. Map generators are those individuals or groups authorised to initiate the production of a map; map makers are individuals or groups who are involved in the deconstitution and reconstitution of spatial reality to produce the map; and map users are those targeted and non-targeted people who purposefully view the map. The model has become known as the *MUGs model,* after the initial letter of the three groups of participants in the mapping process: Maker, User and Generator.

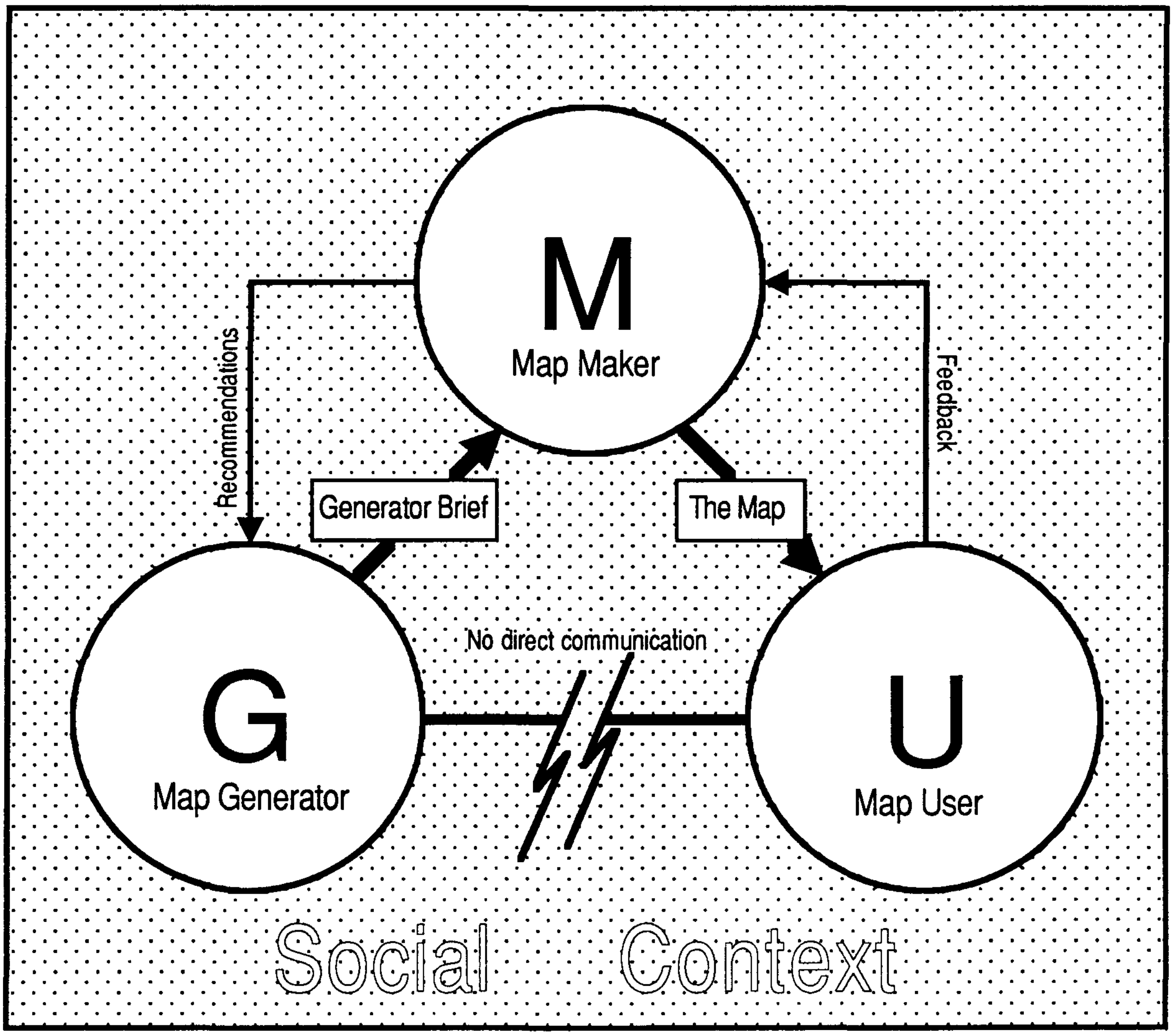


Figure 3.9. The MUGs model: outline.

The middle layer of the model shows the relationships between the participants. The arrows show the direction of influence of each particular participant, moving from those who initiate a given factor towards those who must take account of it. Map generators must take into account the recommendations received from map makers about the mappability of any message. Generator-derived instructions and guidelines are contained within the large arrow labeled 'Generator Brief' and are passed from generator to maker. Map makers then convey the generator's message to users through the map, perhaps aided by the map marketer. While constructing this map they may take into account the perceived interpretative ability (or lack of ability) of the potential audience. The mapping system leaves little opportunity for users to respond to the actions of map generators and map makers.

The third layer depicts the context in which these human relationships are set. This social context consists of structures and institutions shaped to varying degrees by the social formation operating at the time (invariably some form of capitalism). The first and second layers are embedded in this layer: however much any individual or group seek to objectify their part in the process, they remain willing or unwilling participants in a complex interaction ritual set in this social context. The interaction ritual itself is the subject of the next chapter.

The contextual level is the most fundamental. The type and strength of the relationships between the participants is dependent on their context. In turn, the perceived strength of the relationships modifies the actions of the participants. People are free to exercise individual actions within the bounds of their knowledge of how the system works: for example, map users with a complaint or suggestion about a specific map invariably address it to the map makers, not the map generators, because the latter are generally unknown to them. Within the relationships between the participants, the map generator exercises the greatest degree of power.

Relationships between people are therefore read from the surface of the diagram, whereas the dialectic interaction between human agency and social structure is read, as it were, down through the layers of the diagram. This approach is similar in nature to the social theory known as structuration.

Conclusion

Figure 3.10 is a more detailed look at the MUGs model, showing the interaction of the concepts introduced in this chapter and summarised in diagrams 3.6, 3.7 and 3.8. The model? system is not linear in nature, and the movement is not all from generators through makers to users. It has already been shown how map makers might influence map generation and how non-targeted users seek out the map, both active rather than passive responses in the system. It is not predictive in any sense. A model seeking to predict user reaction to a specific map would somehow have to account for the transfer of meaning, and the present author is careful to make no such claim for this MUGs model. It is descriptive, not predictive.

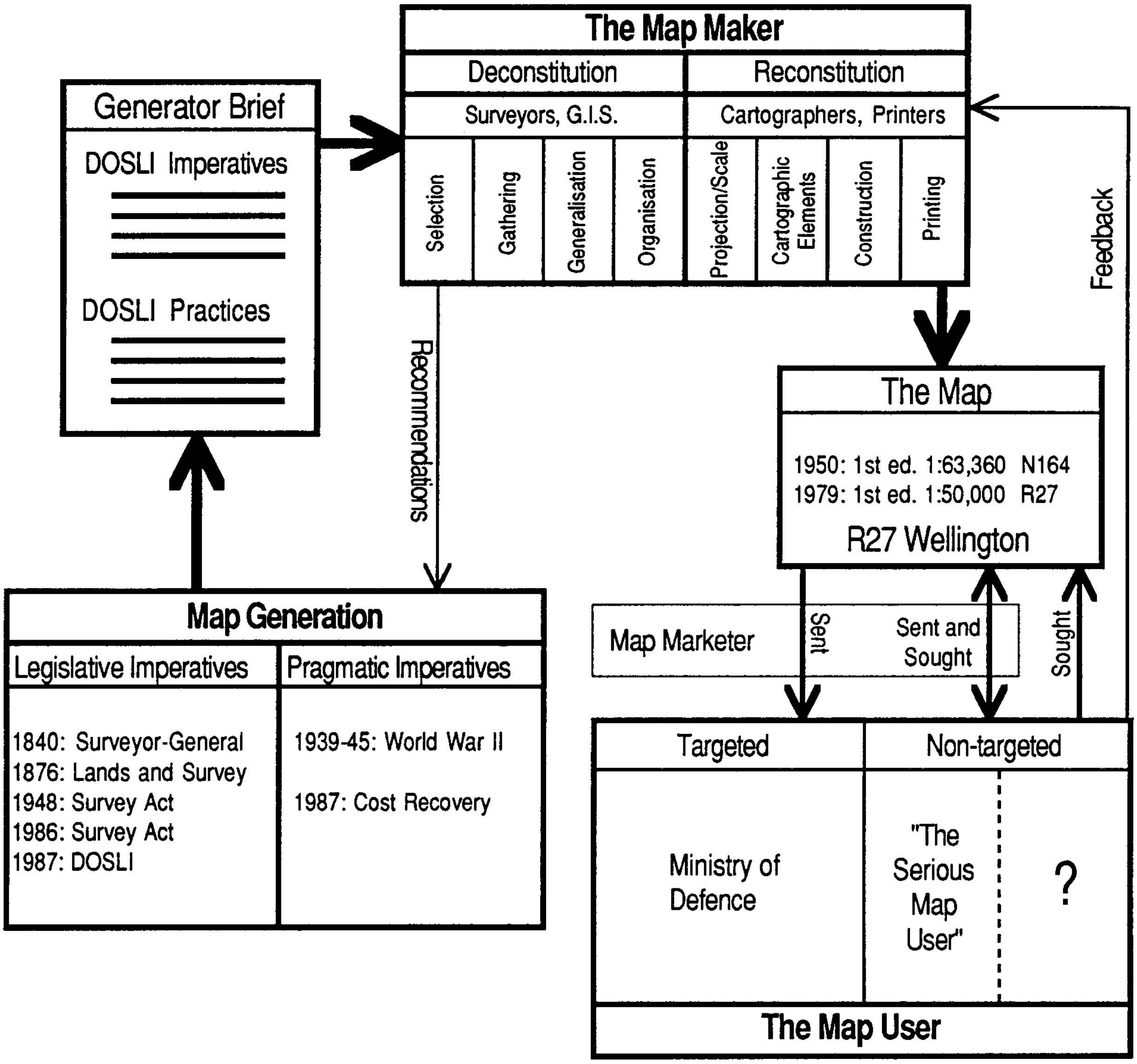


Figure 3.10. The Mechanics of Cartographic Communication: The MUGs model drawn with reference to NZMS 260 sheet R27.

A number of areas present themselves as worthy for further inquiry. First, a closer examination of the relationships among the participants, and between them and their social context is pursued in Chapters Five and Six.

Secondly, in examining the relationship between makers and users, it can be asked how users might be given an active role in determining the form (reconstitution), and even the subject matter (deconstitution) of the map that suits their purposes best. Is this desirable or even possible? This is examined in Chapters Seven and Eight.

Thirdly, the implications for the map generator of greater user input must be considered. To what extent could map users actually begin to determine the sorts of maps society uses? This issue is assessed empirically in Chapter Nine.

While Figures 3.9 and 3.10 may be a more realistic approximation of the mechanics of cartographic communication, three factors remain to be elucidated:

1). By what process generators engender meaning in the minds of users by means of the map.

2). How users recover meaning for themselves.

3). How closely these two meanings coincide.

The next chapter accordingly introduces a discussion on Relevance theory, seeking to show how aspects of its analysis may inform understanding of the evocation of meaning through cartographic communication.

Chapter Four

The Relevance of Maps

Introduction

Relevance theory, a new development in psycholinguistics, is explained and used in this chapter to suggest how cartographic communication might convey *meaning.* The concepts introduced in this discussion and that of the previous chapter are then examined for the insight offered into how misunderstanding arises in cartographic communication

'Relevance' is a theory of communication developed within the context of verbal communication. The basic tenets of Relevance theory, its authors argue, can be applied to many forms of communication. In brief, it supplies a plausible explanation of how context affects communication, and describes the nature of the interaction between the generator of communication and the audience to which the communication is addressed, by demonstrating how the communicative act is driven by the need for relevance. Although it falls short of offering a complete explanation of the mechanics of communication, the concepts it introduces allow the theorist to more closely approximate an understanding of some of the subtler nuances of real-world communication.

Sperber and Wilson (1986) claim a greater degree of flexibility for their theory than is evident in the process or semiotic models of communication. In consequence it is weaker as a predictive tool, as they admit, but they suggest that it is weaker in just the right way in order to allow for the complex nature of understanding. In their assessment there can be no failsafe model of communication. Humans regularly accept the risk of misunderstanding and often exploit it: the pun and *double entendre* allow the communication of humour while still allowing the communicator to have recourse to the literal meaning and deny the implicit meaning, thus saving face in the event of a 'face attack'. Any analysis of communication must therefore allow for the deliberate evocation as well as the inadvertent production of misunderstanding.

Better communication, Sperber and Wilson suggest, is more a process of improvement than of problem-solving. Humans seek improvements in understanding but would not tolerate a perfect communicative system or code that was guaranteed to lay bare the thoughts behind the words. They require room to imagine, infer, misinterpret and impute meanings. None of these complex but nonetheless everyday forms of communicative intent and interpretation can be assessed by process or semiotic models of communication. As it can be shown that in cartographic communication map users infer from context rather than decode from the map, this idea enhances our understanding of why misinterpretation takes place.

Relevance theory will be examined with reference to six major concepts: context, inference, mutual manifestness, ostention, relevance and impositional communication.

The Concepts of Relevance Theory

Context

The notion of context is the first concept taken from Relevance theory with the aim of adding flexibility to notions of cartographic communication. Although the activity of comprehension is global, in that everything might have a bearing on the communication at hand, the almost instantaneous nature of much communication suggests that in practice only that evidence which is immediately accessible is initially taken into account. The factor helping to determine which assumptions and evidence become immediately accessible in any given communicative situation is the context in which that communication is situated. The cognitive element of context can be defined as *that subset of the audience's assumptions evoked by the subject matter of the communication at hand.* This can include aspects of the immediate environment as perceived by the audience, knowledge about the generator of the communication, beliefs about the past and future, rationally held hypotheses, religious convictions, memories and so on. For any particular act of communication some of these sorts of contexts will be strongly or weakly manifest to the audience. Communication is possible only because there is a framework common to most assumptions which can be called 'common sense'. However, the idiosyncratic personal interpretations of many of our common contexts makes perfect understanding rare, if not impossible.

The classic example of this is the differences in descriptions given to the police by witnesses to a crime such as a robbery. Rather than decoding the event using a set of rules, people appear to use perception, cognition and recall to construct unintentionally diverse interpretations of the one event. Our learned 'rules' make understanding possible but do not guarantee its success, even if the grammatical rules of the communication in question are properly applied. This is crucially true of cartographic communication. As noted, map makers have often criticised the map user's lack of knowledge of the 'visual grammar', yet we have seen that misunderstanding may be traceable to other factors.

Another way of stating this idea is to refer to definitions used in verbal communication. An *utterance* is the communicative act, including the semantic code (sentence) and also who said it, to whom, how, where , when and with what intent. A *sentence* is merely a semantic representation of an utterance shorn of context save that which is provided in the sentence itself. *Pragmatics* is the study of the contextual factors of an utterance in verbal communication. Traditional process and semiotic models of verbal communication have focused on the sentence and the grammar used in its construction and interpretation as clues to the evocation and recovery of meaning. It has seemed recently to be more rewarding to linguists to study the *pragmatics of an utterance* than the *grammar of a sentence* in order more insightfully to perceive how meaning is transferred through communication. To follow the linguists, the cartographic theorist needs to consider the contexts of the generation, production and consumption of a map as well as analysing the signs and codes contained within it. Researchers would do better to study the pragmatics of map communication than the grammar of the map.

Inference

"I'll arrive tomorrow" someone says. A purely grammatically-based comprehension might render this as: The speaker will arrive the day after today. Pragmatically-based comprehension, however, allows important questions to be asked, of the sort we all employ in interpretation. Who is "I"? How will "I" arrive? What day is today, so what does that make "tomorrow"? What does "I" really intend? Can "I" be trusted to keep his or her word?

This last question serves to introduce the second important concept, that of *inference.* There is no logical way by which any hearer can decode merely from the semantics of the sentence "I'll arrive tomorrow" any inference as to the trustworthiness of the speaker, yet inferences such as this are regularly required for people to make sense of what they perceive. The addition of the contexts in which the sentence was spoken (pragmatics) will help an inference such as this to be made: in this case, the words were uttered just after the ransom money was handed over to the speaker and in response to the question "When will you bring my husband back?"; and the hearer has the knowledge that the speaker has previously served a jail term for kidnap and murder. Thus, when the speaker says "I'll arrive tomorrow", the hearer can sensibly infer that the speaker is lying. This sort of inference cannot be discerned by grammatical or code rules but is crucially important to the understanding of how meaning is generated from communication.

The concept of inference is central to map interpretation. Figure 4.1 is an enlarged section of NZMS 260 R27, highlighting selected contour lines. These lines themselves are first-order inferences made by map makers on the basis of approximations generated from a limited number of more precise measures (e.g. benchmarks). Stephen Toulmin refers to this process as 'theorising' (Toulmin, 1968). The 'x' marks the position of a male map user who is using the map for locational purposes during a pig hunt. A second-order inference must be made by the map user to estimate his altitude. This inference might be something like this: "About halfway between 120 and 140 metres, so about 130 metres." A closer look at the map may lead to a third-order inference such as "The map may not be accurate since photography was completed in 1980" made because of another inference "It looks like there has been a slip of some kind here and the map doesn't seem to show it" and so on. Meaning is inferred from a combination of the data on the map proper, a first-order inference from that data made by the map maker, a second-order inference from these inferences made by the map user, an inference from the immediate environment which makes the date of photography on the map margin relevant, which is then combined to make still another inference - a complex procedure but one that is routinely conducted. Just as the hearer asked herself whether the kidnapper could be trusted, so the pig hunter may be led to ask whether the map (or more properly the map maker) can be trusted. Such questions are often asked but are amenable to study only with reference to the concepts of context and inference.

Sperber and Wilson suggest that audience inference works not by any system of logic or code that leads to successful or unsuccessful communication, but rather by *suitably constrained guesswork* that leads to various degrees of understanding or misunderstanding. Such inference is 'suitably constrained' because of the need to use easily-recoverable contextual information; and 'guesswork' because of the need to infer from much of the information presented by the generator.

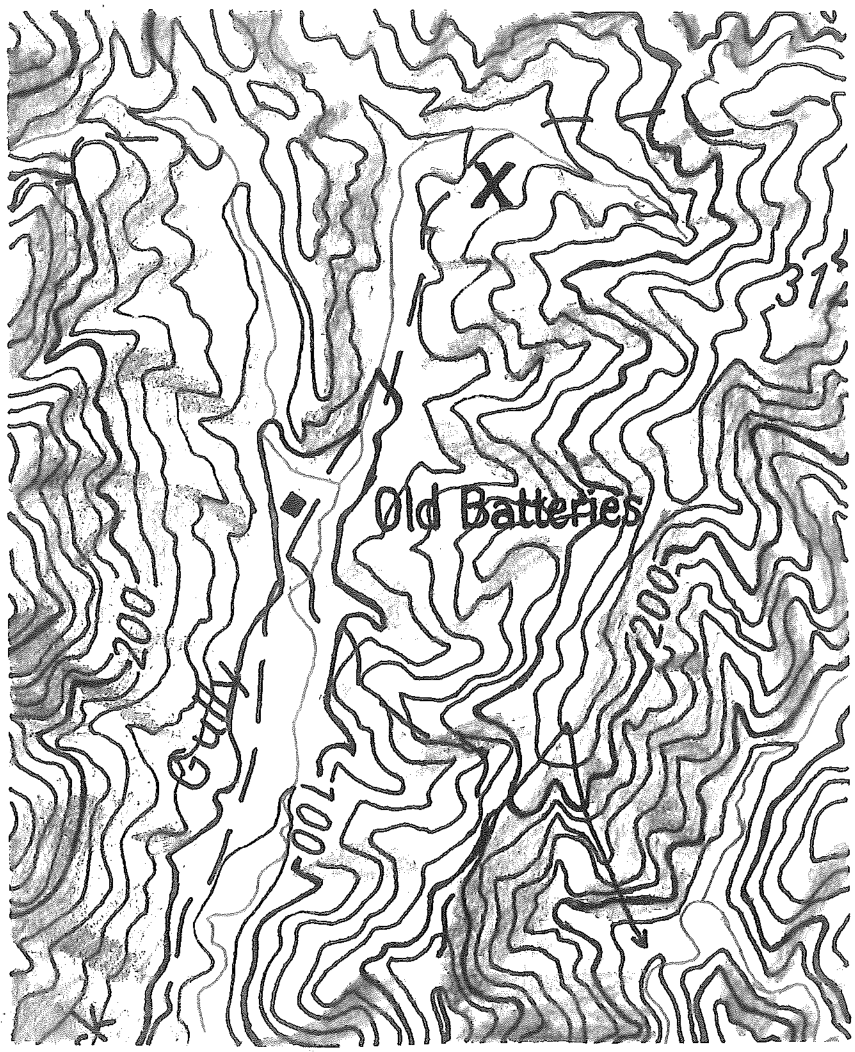


Figure 4.1. Map Inference. Enlarged and redrawn excerpt from NZMS 260 sheet R27 Wellington: edition 2, 1983; limited revision, 1986.

In 1956 Isaac Asimov wrote a short story called The Watery Place in which two strangers asked a local sheriff in a desert town to take them to the nation's leader. Dismissed as crackpots by the sheriff, they clambered back aboard their hidden spacecraft and were spotted by the deputy. It transpired that the initial meeting between humankind and an alien species was thwarted by a misunderstanding: the strangers had told the sheriff that they were from a 'watery place' that he had heard as 'Venice' when, in fact, they meant 'Venus'. This is not a simple misinterpretation of a sign.

Misunderstanding was engendered by the hearer not expecting the smartly-dressed strangers to say 'Venus': there was insufficient context supplied for the sheriff to make a correct inference, and he made the best inference he could based on what he thought he knew. We can all think of less fantastic examples of how misinterpretation springs from ill-founded inference based on the contexts we think we share but are, in fact, idiosyncratic (in this case, to humanity).

Mutual Manifestness

How can people know that they share contexts and knowledge without actually telling one another? In the example of mapping, how can generator, maker and user share contexts when, typically, they never meet? It is obvious that something must be held in common for the audience to entertain thoughts similar to those which the generator seeks to evoke. Sperber and Wilson suggest the condition of *mutual manifestness* to explain this commonality.

That which is perceivable or inferrable by an individual is manifest to him or her, even when it is not consciously entertained. For example, the doorbell is ringing. While it might be strongly manifest that someone is at the door, it is still manifest - but probably unconsciously - that the person in question is tall enough to reach the bell, that the bell has not been stolen, and so on. The cognitive environments of different people are made up of experiences, ideas and beliefs that are manifest in varying degrees of strength. The intersection of two or more people's cognitive environments allow mutual manifestness to be inferred. This does not mean that they must make the same assumptions; it merely means that they are capable of doing so (Sperber and Wilson, 1986).

People may infer that they share cognitive environments, and expect that they will share a degree of mutual manifestness, without having to know anything about the other person. This allows decisions to be made and communication to be entered into on the basis of inferences and assumptions drawn from the fact that the cognitive environments will, to some extent, be mutually manifest. It could be suggested here that the more mutually manifest the cognitive environments of generator and audience, the more meaning might be recovered from any communication. For example, if Eric and Doug share the environment "Room 304", and the phone in that room is ringing, it will be manifest to each of them that the phone is ringing and it will be manifest to each that it is manifest to the other that the phone is ringing. A common context exists from which inferences can be made: "He hears it too but isn't answering: he expects me to answer it or maybe he doesn't want it answered." The inferring of common contexts known as mutual manifestness is essential to the act of communication, whether verbal or visual.

Essential though it is for all forms of communication, in practise mutual manifestness is quite different in character as an element of cartographic communication to the simple argument constructed by Sperber and Wilson. The complicating factor is the temporal and spatial divide that may exist between generator and user. The situation is analogous to, though not as exaggerated as, a scholar reading Chaucer who has to reconstruct many of the social and historical contexts of the author in order to understand the communication. In most cases, the apprehender of visual communication gets only one chance - the visual image itself - to understand the communication. On the other hand, many verbal statements are merely opening negotiations. Compare (1) Doug saying to Eric "Look at that church!" where Eric either sees the building but doesn't realise it is a church, or doesn't see it at all, with the case of (2) Doug drawing a map for Eric containing, among other things, the mapped location of the church. There are some clear differences in the type of communication here.

(a) Eric can interrogate Doug about his verbal statement in order to make Doug's context manifest to himself. They can conduct a dialogue on the subject. The drawing of a map implies that, unless Doug is physically present when Eric reads the map, Eric can interrogate the map only and not Doug himself. Because cartographic communication generally is not iterative, both Doug and Eric must try to get it right first time.

(b) Non-verbal communication is generally weaker than verbal communication in promoting manifestness. In the first case Doug is saying one quite explicit thing to Eric, and Eric cannot help but notice this with Doug's ostensive behaviour. With the map, however, Eric may not be able to tell which of the many things Doug has mapped are supposed to be strongly manifest. While verbal communication allows the audience to pin down the generator's explicit content to "one strongly manifest candidate" (Sperber and Wilson, 1986: 60), maps present many weak candidates for manifestness, leaving the audience to do a lot of guesswork. This is particularly true of the non-target audience who may not be aware of the reason why the generator has produced the map.

These differences, rather than leading to the rejection of Relevance theory as applied to visual communication, serve to show more clearly the special character of the map. *A map is a non-iterative device designed to present many items of weakly manifest information so that the user might infer the relationships between them.* Were one piece of mapped information always to be strongly manifest (as is the case with some advertising and 'thematic' maps), the rich detail of spatial interrelationships would be lost to the map user.

The rule is clear. If the generator requires to communicate one specific piece of information, he or she should either make it strongly manifest on the map or consider another form of communication more amenable to making information manifest. If, however, the generator wishes to present many weakly manifest pieces of spatial information (such as 'oil-bearing deposits'), then the map is the best tool available.

Aspects of Relevance theory can inform the first fundamental difficulty with traditional ideas of cartographic communication, developed in Chapter Three as the intention of the map generator. In order to communicate effectively, the generator must be able to infer something about the cognitive environment of the intended audience, and suit the communication to what is inferred about this audience. This is similar to the approach a university lecturer might take when preparing a lecture for second-year students: she will probably realise that she is able to build upon what the students have learned in the previous year. She is not required to *know* whether the students have learned, and this lack of knowledge may temper her desire to present wholly new material, causing her to include a number of introductory remarks to remind the students of what she believes they ought to already know. In this she seeks to strengthen that which she believes to be manifest to the students.

It can be argued that the legend or key of a map performs much the same function as the lecturer's introductory remarks. The map maker reminds the audience of what they ought to be manifest to them and, in so doing, makes things manifest to those for whom they were not. The activity of providing a key is a way to make certain ideas mutually manifest to generator and user even when separated in space and time. An important intention of the map generator, then, is to establish the conditions for mutual manifestness.

Ostention

Sperber and Wilson suggest that communication is initiated by an act of *ostention*. An ostensive act is one that signals to the audience the intention to communicate. It suggests that something worth attending to is about to take place. In verbal communication ostention might be a clearing of the throat, an introductory statement or the shout "Pay attention!" In cartographic communication the map title, a catalogue or a display in a window could all be regarded as ostensive acts of varying strengths. *An ostensive act attempts to tell the audience that something is to be made manifest.* Ostensive stimuli help us decide what to attend to and what to ignore. We may approach any stimulus with the hope of finding something of interest, but when confronted with an ostensive act directed towards us we have a raised expectation that what is to be communicated will be relevant to us. *Ostention comes with a tacit guarantee of relevance.*

Combining the concepts of contextual inference and ostention leads to the formulation of the idea of *ostensive/inferential communication*, central to Sperber and Wilson's analysis. Simply put, the generator is involved in acts of ostention and informing, while the audience responds with acts of contextual inference. Following from this, two levels of communication can be identified as having been generated and needing interpretation:

1). The communicative intention (ostention) and

2). The informative intention (the content).

The distinguishing of these two intentions as shown by Figure 4.2 is crucial to the argument. Although the recognition of ostention is not necessary for the apprehension of meaning, "someone who fails to recognise this intention may fail to notice relevant information" (Sperber and Wilson, 1986: 50).

Generator	The Communicative Act	Audience
Initiative		Response
1. Communicative Intention (ostention)	--------→ ←--------	1. Establishing of contexts
2. Informative Intention (message)	--------→ ←--------	2. Inference

Figure 4.2. The communicative and informative intention.

The concept of ostensive/inferential communication is important in an analysis of cartographic communication. The basic questions that are asked by an audience about an ordinary, non-cartographic act of ostention might be summarised as "What is the generator's ostensive intention to me?" and, even more fundamentally, "Does the generator intend me to apprehend the message?" Unlike most other apprehenders of communication, map users are not encouraged to ask these questions.

For example, even a detailed examination of the map extract found in Figure 4.3 is unlikely to recover one of its most important messages. An examination of an earlier map of the same area (Figure 4.4) shows that the Royal Ordnance factory that existed (to produce nuclear weapons) in 1973 has been removed from the 1980 map. It still exists in reality, but the ostensive message of the map ("I am produced by highly trained technicians with the purpose of showing what is really there") found in the title, key, and the many peripheral references to accuracy of measurement and preciseness of location actually masks another message ("We don't want you to know where the nuclear weapons factories are").

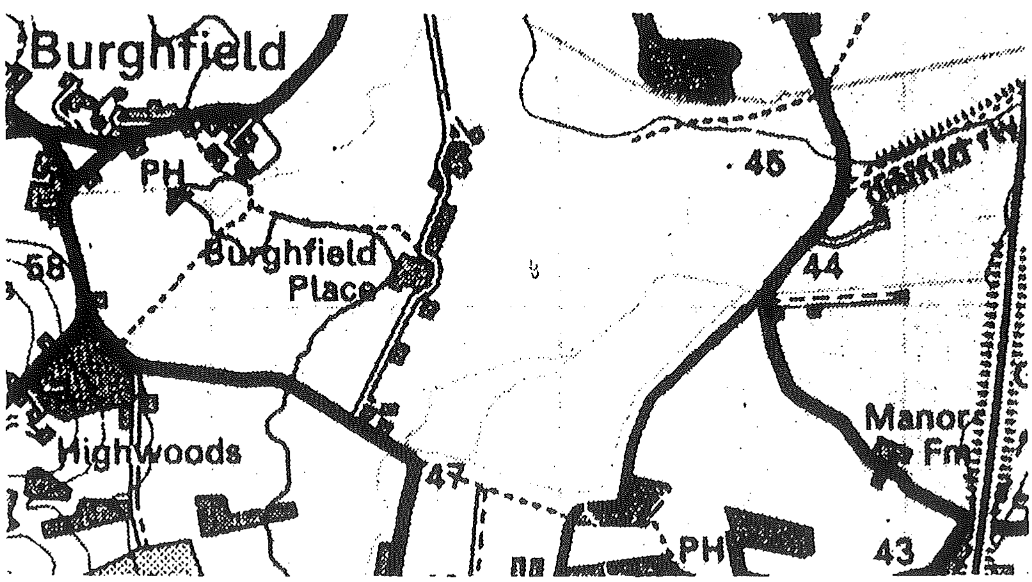


Figure 4.3. Enlarged extract from Ordnance Survey 1:50,000 topographic map, Burghfield, 1980. Source: O'Keefe, 1982: 49.

Both maps are ostensive, in that they are produced, labeled and marketed. However, at least one meaning in the 1980 map is hidden from many map users because it is unannounced, is not ostensive, and is only recoverable by users who have access to both maps and who know something about the environment that is the subject of the map. The uncovering of the intention of the map generator (the communicative intention) modifies what a map user might find relevant in the content of the map (the informative intention).

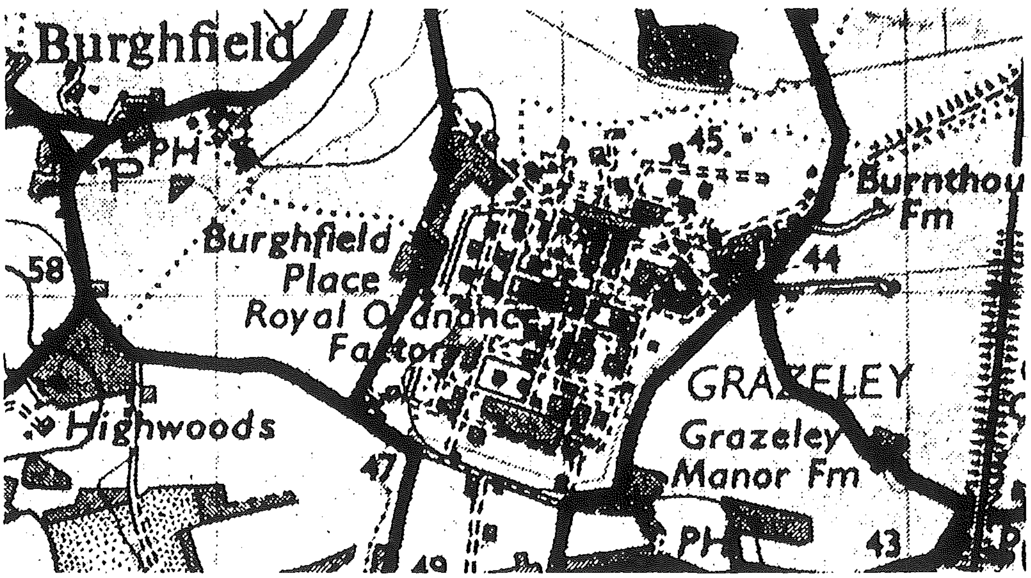


Figure 4.4. Enlarged extract from Ordnance Survey 1:50,000 topographic map, Burghfield, 1973. Source: O'Keefe, 1982: 49.

Many communicators cannot afford to have their potential target audience miss out on the information provided, and so employ strongly ostensive communication. An obvious example of this is the work of advertisers, for whom ostension is a form both of attention-getting and audience enlargement. Another example from the world of cartography illustrates the centrality of ostention. Many cartographic conferences now have insufficient time for the presentation of all papers offered and so employ poster presentations. Each poster has but a moment to capture the attention of a potential audience as people walk past. Many posters are, therefore, designed to be deliberately garish, and break cartographic 'rules' to do so, in order to highlight the communicative intention. Ironically, this is often to the detriment of content clarity (Tom Poiker, *pers. comm.*, 1987).

Harley encapsulates these arguments by writing:

> "All maps strive to frame their message in the context of an audience. All maps state an argument about the world and they are propositional in nature. All maps employ the common devices of rhetoric such as invocations to authority (*especially* in scientific maps) and appeals to potential readership through the use of colours, decoration, typography, dedications, or written justification of their method" (Harley, 1989: 11).

Relevance

Sperber and Wilson suggest that relevance can be defined in cost-benefit terms:

> "Human cognitive processes... are geared to achieving the greatest possible cognitive effect for the smallest possible processing effort." (Sperber and Wilson, 1986: vii).

Optimal relevance can thereby be written as a sum:

Optimal relevance = maximum effect - minimum effort.

Relevance itself is seen as a balance between cost and benefit, effort and effect. An effect can be as vague as a potential improvement in emotional well-being or as specific as an answer to an examination question. Something is relevant if the effort to gain a potential effect is judged 'worth it' by the hearer, in terms of the likely effect. An audience ceases to attend to a communication when the extra processing effort required to apprehend an idea appears to outweigh the perceived benefit of that idea. Relevance is, therefore, a relative rather than an absolute concept. Stimuli might be <u>marginally</u> relevant due to *high effect - high effort* or *low effect - low effort*, <u>highly</u> relevant due to *high effect - low effort* or <u>irrelevant</u> due to *low effect - high effort*. Effects and effort will, of course, change constantly as long as communication and cognition continues.

The concept of relevance extends beyond the interpretative acts of an audience to the initiatory acts of generators. In order for the generator's time and effort not to be wasted, he or she would wish the potential audience to know that he or she believes the communication to be relevant. As discussed, this underlies the ostensive act. Further, the audience makes the assumption that the ostensive stimulus, or medium of communication, is the most relevant that the generator could have chosen. Together, these assumptions make up the principle of relevance: *every act of ostensive communication communicates the presumption of its own optimal relevance.* (Sperber and Wilson, 1986: 158). Thus by the ostensive act the generator implies that the information to be communicated is relevant, and the audience continually test this implication using their individual criteria of effect and effort.

Impositional Communication

In much of this work the tacit assumption of generator and audience cooperation is made but remains largely unstated. Paddy Austin (1987) has shown that, for verbal communication at least, this assumption is unwarranted. Her doctoral work, entitled <u>The Dark Side of Politeness</u>, develops Brown and Levinson's ideas about 'face attacks', combining them with Sperber and Wilson's 'Relevance' theory to analyse strategies of deliberate impoliteness containing within them definite power relations.

Austin shows that the idea of *degrees* of ostensive intention is crucial to understanding the evocation of double meaning. If, for example, a boss notorious for his sexual harassment asks a female employee to remain at work after hours, the explicit or apparently ostensive communication can be inferred to mean that he wishes her to work, but the *implicit intention* can be inferred as an invitation to a sexual encounter. In this sort of communication the power resides totally with the generator, for if the speaker wishes to mask rude, threatening, deceitful or coercive communication, the onus is on the hearer to uncover this and respond, or to be trapped into fulfilling the wishes of the speaker. To respond to the implicit intention puts the hearer at risk. Moreover, the speaker can deny the implicit intention and point to the literal meaning. In this sort of analysis the choice of response made by the hearer and the type of remark made by the speaker depend on the satisfaction of face needs. The speaker may choose a strategy of implicit communication in an attempt to preserve face while imposing upon the hearer's negative face. Will the hearer threaten the speaker's positive face with an overt response, or will she accept the imposition of power relations by either excusing herself from the extra work or acquiescing to it, thus preserving her boss's positive face while accepting a negative face imposition?

This concept allows the framing of an argument to be developed in the next two chapters. It will be shown that *non-iterative cartographic communication encourages the engendering of unequal power relations.* The Burghfield example (Figures 4.3 and 4.4) illustrates how maps can serve to remove from map users knowledge and therefore power to act, thus imposing upon the negative face of the audience to that map. Telling this cartographic lie was an attempt to limit the public knowledge of the whereabouts of nuclear facilities at a time of increasing opposition to such facilities. The power of the implicit communication is the inability of the audience to apprehend it from the map. Selective provision of information, made under the assumption of full provision, emphasises the power of the information provider over the recipient.

In summary, the conceptual contribution of Relevance theory to the study of cartographic communication is to theorise that, with both generator and user aware of what might be mutually manifest to them, map generators initiate ostensive communication from which users attempt inference until they reach the point where processing effort outweighs perceived effects. This communication is believed by the map user to be co-operative but this is not guaranteed.

Extensions of Relevance Theory

Elements of Relevance theory can be combined with concepts presented in the previous chapter to suggest two further sources of misunderstanding. These are examined in turn.

Informational Barriers

John Keates' diagram summarising the barriers to cartographic information (see Figure 3.1) can be given much more explanatory sense with reference to 'Relevance' theory. For example, the choice of a map unsuitable for the map user's purpose may be the result of the generator's ostensive intention being too weak for that person. Not being targeted by the map marketer may lead the map user to abandon the search for a suitable map.

The idea of informational barriers is crucial to understanding how Relevance theory might be applied to access to cartographic information.

Presumably the effort required to actually locate the map to begin with will have some effect on the map's subsequent relevance. An argument could be suggested to explain what might happen in the case of a user overcoming a high informational barrier. The map will quickly be discarded if it is clear that it will not produce the high effect needed to counter the already high effort expended. The effort required to locate the map is included as part of the relevance equation, so that, at the outset of the user interpretation exercise:

degree of Relevance = x contextual effect - (high locational effort + y processing effort)[1]

with x and y yet to be determined, x needing to be high to produce even marginal relevance. It could, in fact, be argued further that if the perceived effect is low enough the exercise may be abandoned even before the map is found, so that locational effort becomes an integral part of the concept of 'effort'. The relevance equation should then be represented as follows:

degree of Relevance = x contextual effect - y locational and processing effort.

The obvious implication of either argument is that to raise relevance for map users, locational barriers need to be lowered. This can be done by strengthening the generator's ostensive intention while widening the target audience.

Message and Need Conflict

Changes of a more fundamental nature are needed in order to overcome another major obstacle. In the case of sheet R27 the initial targeted audience of the map message, the military, has had a profound effect both on the subject matter and the form of the map. The nature of this message has been preserved in spite of the attempt to widen the target audience in the interests of cost recovery. It can be argued that the subject matter and form of the map, as determined by the message of the generator, may well interfere with the effects that map users seek to gain from the map.

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[1] The representation of these concepts in the form of equations in no way implies a predictive function, as so much of the strengths of these concepts as held by real-world individuals depends on the degree of manifestness of contextual elements, elements which cannot be recovered, let alone entered into an equation.

The argument runs as follows, as applied to topographic maps:

1). The initial purpose of topographic mapping was to provide information to the military.

2). Responding to cost-recovery imperatives, the generator's ostensive intention is widened to welcome previously non-targeted users through the efforts of map marketers.

3). Previously non-targeted users have been encouraged by this ostensive intention to seek relevance from the map.

4). However, the map message is still about the original subject matter and couched in the original form, with perhaps a few minor modifications.

5). Users have their own specific needs for which they approach the map.

6). Not being privy to the nature of the original message, the user cannot infer the nature of the original communication in order to separate it out.

7). The generator's original intention therefore conflicts with the needs of users who were latterly invited to recover relevance from the map.

8). Few people use the maps (Aitken *et al*, 1985).

In New Zealand the Department of Survey and Land Information has responded by creating 'thematic' maps (e.g. National Park maps) containing information they consider relevant to these users. Because they are based on topographical maps, they are unlikely to solve the problem. While highlighting information considered relevant (thus strengthening the ostensive intention), the original subject matter and form of the map still inhibit the map user.

Conclusion

'Relevance' theory can be sharpened into a powerful tool for the examination of the relationship between map generator and map user as expressed by the dynamics of cartographic communication. The analysis reveals a number of critical areas of interaction where the potential for misunderstanding exists. These are:

1). *Insufficient mutual manifestness.* The generator and user are typically separated by space and time, and a number of unwarranted inferences might be drawn by both generator and user (e.g. "Users know cartographic conventions" or "Map makers always tell the truth").

2). *Lack of iteration.* The durability of the map medium means that the map user has only one 'utterance' to interpret and cannot ask questions to resolve misunderstandings. This reduces the relevance of the map as a general communicative device, as a great deal more processing effort is required to infer meaning from one complex non-iterative utterance than from a dialogue.

3). *The 'Eavesdropping' effect.* Map users who are not targeted by the ostensive act of the generator may fail to apprehend relevant information or misunderstand the nature of the communication. Further, the lower degree of mutual manifestness between a generator and a non-targeted audience may diminish the level of relevance.

4). *Lack of relevance.* The effect gained from processing a complex document may not prove worth the effort and the audience may cease to attend to it.

5). *Unequal power relations.* Map users "tend to place inordinate faith in maps and accept them as true and complete representations" (Tyner, 1982: 40). Knowing this allows map generators to claim scientific accuracy while selecting the information given to their audience to meet their own needs, not those of their audience. In this case a correct interpretation of the map is actually a misunderstanding of the real situation.

6). *Informational barriers.* The difficulty a map user has in gaining access to a potentially relevant map may influence the level of relevance provided by that map.

7). *Message and need conflict.* The form and content of a map is designed to meet the needs of the initially targeted user. Other users may find that aspects of the subject matter of the map, or the way in which it is presented, obscures the information they are seeking.

The discussion in this chapter raises a number of important questions. It has been argued that one of the central areas of potential misunderstanding lies in the intersection of the explicit and implicit intentions of the map generator, and the needs of the map user. Statements have been made suggesting that, in fact, the purposes of map generators are often quite different to (a) the needs of the map user, and (b) the ostensive intention of the map generator. It can be inferred from this discussion that map generators use maps in an exploitative manner, taking advantage of the breakdowns in understanding that occur. This argument requires examination with reference to historical and contemporary real-world examples. This is the purpose of chapters Five and Six, which comprise Part Three of this thesis.

Chapter Five

The Historical Development of Cartography

Introduction

J.B. Harley outlines what he sees as the task facing reviewers of cartographic history:

> "... to search for the social forces that have structured cartography and to locate the presence of power - and its effects - in all map knowledge" (Harley, 1989: 2).

This historical review is being undertaken to examine empirically the concepts discussed in Part Two of this thesis. Verification of these concepts will be sought in the general pattern of cartographic history and in specific historical examples of maps and their generation. The task of this chapter is to examine, using specific historical examples, how maps have been influenced by and have influenced the social contexts in which they were created.

The frameworks examined in Chapter Two suggest that to this task should be added the search for the self as motivating and interacting with these social forces. Chapter Four amplified this concept of the self, suggesting that cartography is a complex form of communication which incorporates unequal power relations motivated by self-advancement.

Chapter Three introduced the fundamental idea that map makers were generally not the initiators of the map products consumed by society. It was argued that their activities were embedded in a context consisting of social forces influencing both the subject matter and the form of maps. It was argued that this group, labeled 'Map Generators' in this thesis, initiate the communication that is represented by the map, its content and context. It was then argued that many of the causes of user misinterpretation can be traced back to the intention of the map generator.

The present chapter pursues these ideas in a different but complementary direction. It investigates the types of messages that map generators historically have sent, tracing their influence on the form and content of maps and on the worldviews of map users. It is argued that maps have been employed by their generators to communicate what in Chapter Two were called 'overall' messages, and in Chapter Four were identified as 'implicit intentions'. These messages are egocentric in nature, designed to advance those who generated them. Egocentrism is shown to have led to ethnocentrism and to Eurocentrism. Maps are shown to have been employed as a powerful legitimising force in imperialism and colonialism, both of which have shaped contemporary society.

The chapter consists of two main sections. The first is a review of the origins of cartography, in which it is shown that cartography has been an expression of cosmological belief centred on the self. A clear link is exposed between cosmology, cartography and anatomy, suggesting that maps and the science that created them are influenced by non-rational considerations. The second section reviews how cartography has developed into a sophisticated, ritualised communications system designed to advantage some people, communities and nations over others. From the perspective of this thesis, cartography is said to be impositional in nature, threatening the negative face of those it seeks to disadvantage.

Cartographic Manifestations of Self-Centeredness

There exist a number of traditional accounts of the historical development of cartography. Their main object is to describe the growth of mapping from scratchings on clay tablets to the precise science of contemporary cartography. Behind this work lies an unstated assumption about the development of mapping. It is most clearly suggested by Crone, who said that

> "... the history of cartography is largely that of the increase in the accuracy with which...elements of distance and direction are determined and...the comprehensiveness of the map content" (Crone, 1953: xi).

The histories are about the stages in the development of an accurate and comprehensive Euclidean map coverage and these enthusiastic cartohistorians consider each extant map or map fragment as a treasure, viewing them as signposts on the road of cartographic progress rather than destinations in themselves.

The work of cartographic historians leaves a number of important questions unanswered. Why has cartography developed in the way it has? Why did it develop at all? Whose needs were served by its proliferation? The answers to such questions can only be considered in a wider review of the development of cartography such as is attempted here.

Egocentrism

Following Yi-fu Tuan (1974), this discussion of how and why humankind began to construct communicable spatial representations begins with self at the centre. It could equally have begun, as Harley (1989) suggests, with a consideration of social forces. Both must be taken into account when considering the historical development of cartography.

"Egocentrism", Tuan says, "is the habit of ordering the world so that its components diminish rapidly in value away from self" (Tuan, 1974: 30). That people have constructed and expressed spatial relationships in an egocentric fashion, and continue to do so, is readily established. Tuan uses a study by E.S. Carpenter (1955) to show how Ailivik Indians sketched the shape of the island upon which they lived (Figure 5.1). He notes that although the outlines drawn by the Eskimos are extraordinarily accurate in their placement of detail, the sketches differ from the 'true' shape of the island in one significant respect: the exaggeration in size of Bell Peninsula, where most of the Ailivik live. Tuan notes: "The tendency to exaggerate the size of one's home ground at the expense of the territory of neighbours is well known" (Tuan, 1974: 34). Size exaggeration is the most obvious, but not the only, manifestation of egocentrism in spatial relationships.

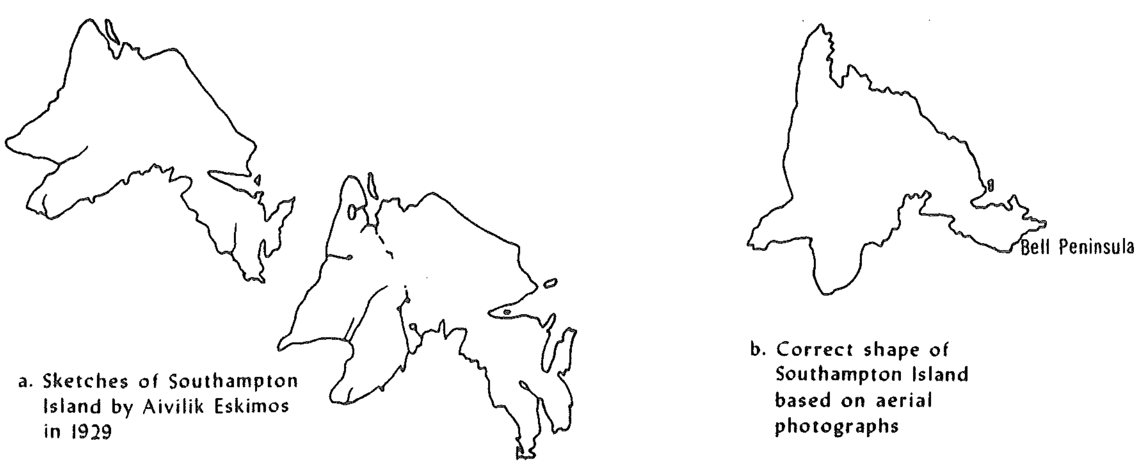


Figure 5.1. Ailivik images of Southampton Island. Source: Tuan, 1974: 34.

The graphic expression of people's cognitive maps is another example of humankind's tendency to egocentrism. Gould and White (1974), among others, note that mental maps are drawn from an amalgam of personal experience and prejudice, invariably focusing on the known worlds of the mappers. Figure 5.2. is one of 150 sketches drawn by first-year geography students at the University of Canterbury in response to the prompt "draw Christchurch as you see it". In this case, as in most of the others, the home area is centred and exaggerated at the expense of areas of lesser importance to the mapper. This is in spite of the fact that Christchurch is laid out in a regular pattern and in 'The Square' has a clearly acknowledged centre. Eastern suburbs, areas into which students have little cause to venture, are much less important. This egocentric pattern echoes that discovered by Gould and White (1974). Their work records many instances of the correspondence of blank spaces on maps to *terra incognita,* with map detail found close to places known and regularly frequented.

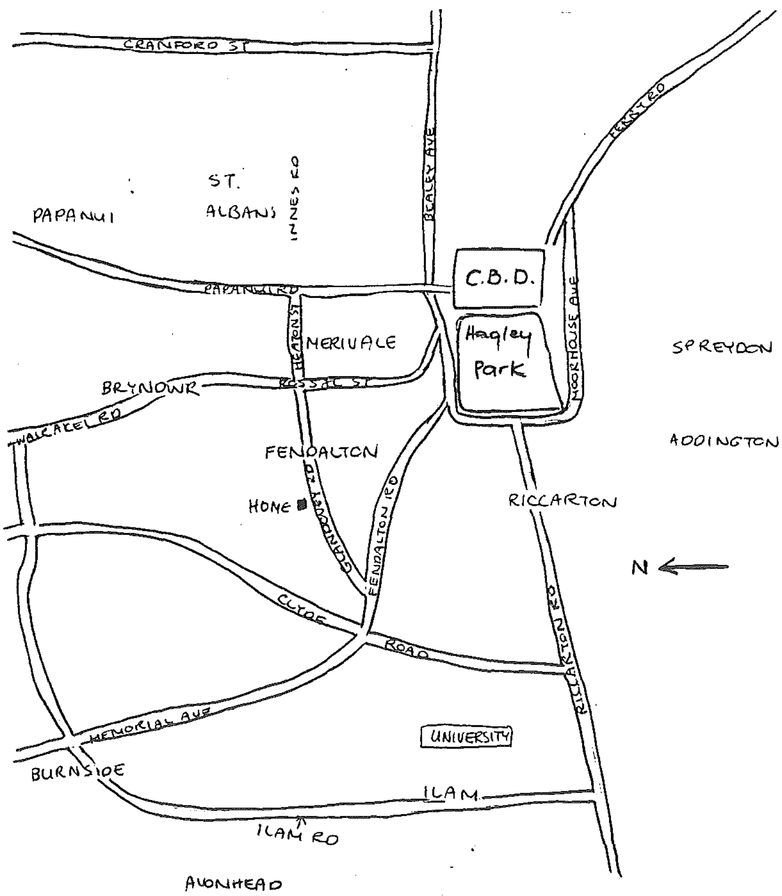


Figure 5.2. Cognitive Image of Christchurch.
Drawn by a first-year geography student, University of Canterbury.

Ethnocentrism

Collective egocentrism, known as ethnocentrism, expresses itself firstly in cosmology. This is to be expected for, as shown by Harrison and Livingstone (Chapter 2), cosmology - beliefs about the origin of reality - is the most fundamental presupposition. Moreover, historical links have been uncovered between cosmology, astronomy, geometry and cartography, and it is a contention of this present argument that particular social ideas of the nature of cosmology (as expressed in religion) predicate astronomy, geometry and thus cartography.

Tuan demonstrates how the cosmologies of many communities are based on the exclusionist notion of 'us' and 'them', with 'us' being centralised and emphasised and 'them' being marginalised in ways not unlike those expressed by first-year geography students. The Yurok Indians, for example, saw their world as a circular disc with themselves at the centre (qe'nek). Their world is shown in Figure 5.3, a diagram drawn not by the Indians themselves but by a researcher to summarise their cosmology. Maps of cosmological belief can be referred to as *cosmographies*.

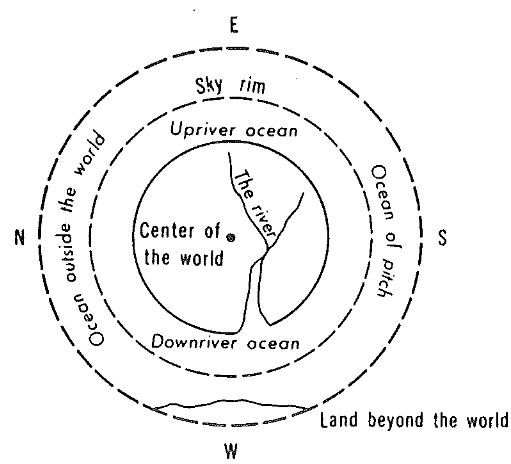


Figure 5.3. Cosmography of the Yurok Indians. Source: Tuan, 1974.

The earliest extant world map is of similar fashion, being an example of Babylonian cosmography from the 5th century B.C. (Figure 5.4). Geometric elements such as the circle were seen to have religious significance, and were used to emphasise the dominance of the culture from whence the map was produced. This reflects and reinforces an ethnocentric worldview. In fact the circle is fundamental to a primitive ethnocentric view of the cosmos: "more than any other shape the circle implies a centre" (Tuan, 1974: 38). This fundamental cosmographic shape may have been developed in one or more of the world's wide open areas, where the horizon in all directions appears the same distance removed from the viewer, who seems to be in the centre of the world. Alexander Marshack (1972) suggests that the pre-historic ancestors of humankind survived because they noted and used the circularity of celestial movements to aid them in seasonal prediction and the gathering of food. Thus it may be that humans, surrounded by a world of circles on which they depended, came to see themselves as the centre of all things.

Figure 5.4. The first world map. Source: Hodgkiss, 1981.

Samuel Edgerton calls the ethnocentric world view the "omphalos [umbilicus] syndrome, where a people believed themselves divinely appointed to the centre of the universe" (Edgerton, 1986: 26). Just as the umbilicus is seen to be the physical 'centre' of the human body, so each group of humans are seen by themselves to be the physical and spiritual centre of the world. Therefore, the omphalos syndrome leads to assumptions of primacy of origin and position (we are the first and the central people). Such beliefs about the primacy and centrality of their own group are found in many cultures throughout the world (Tuan, 1974).

The omphalos syndrome links the anatomical with the locational and the celestial: person, place and cosmos revolve around an axis fixed at the centre, or origin, of the self. Edgerton comments:

> "Some anthropologists have been so struck by the spontaneous, nearly universal cosmological planning {around the self] that they have given it a name - 'astrobiology'" (Edgerton, 1986: 17).

Here geometry, astronomy and cosmology is allied with the self to assert that 'we are the centre of the universe'. In both astronomy and cartography this view was formally held until the Renaissance, while in everyday life it may still be individually and collectively subscribed to.

At first this ethnocentric belief is inwardly focused. While something may be known of surrounding peoples, most attention is paid to the spatial and social dynamics of the home group. It is only when this group is forced to interact with other groups that the need is found to assert their own centrality and primacy (Edgerton, 1986). Soon enough is known about other peoples to lead to the realisation that the home group has no logical claim to centrality. In circumstances where the evidence does not warrant it, a continuation of such ethnocentric belief is recognised as cultural or racial prejudice. In terms of the perspective of this thesis, such belief in the face of the evidence is wrong in that it may be used to justify the procurement of sovereignty over other selves. In other words, the ethnocentrism becomes outwardly focused, impositional rather than merely assertive.

The development of classical Greek cartography illustrates the consequences of an ethnocentric worldview clung to long after the evidence had proved it inaccurate. Figure 5.5 depicts in cartographic form the Homeric view of the world, a view from Greek antiquity (Tuan, 1974). With the discovery of lands beyond the Mediterranean, statesmen realised that Greece could no longer occupy the privileged central position it previously held in the minds of classical thinkers and their works.

At the same time, the adoption of Pythagorean philosophy and geometry led to an emphasis on the *orthogonal* (the perpendicular and the straight line). Alexander the Great used Pythagoras' mathematics to organise the world which he conquered, remaking cities on a grid pattern of intersecting orthogonals. "Nurtured on Pythagorean faith in the transcendent, soothing effects of geometry", Alexander "... made the grid the trademark of Greek civilisation in the inhabited world for centuries thereafter" (Edgerton, 1986: 19). Alexander's own city, Alexandria, expresses the grid concept, as shown in Figure 5.6. Not surprisingly, it was at Alexandria that the fathers of modern scientific cartography worked: Strabo, Eratosthenes, Hipparchus and Ptolemy himself. In a gridded city that carried the name of the most effective imperialist the world had yet known, these cartographic visionaries extended the orthogonal map grid to the end of the known world and beyond, as evidenced by the cartographic grid (graticules) found on reproductions of Ptolemy's world maps (Figure 5.7).

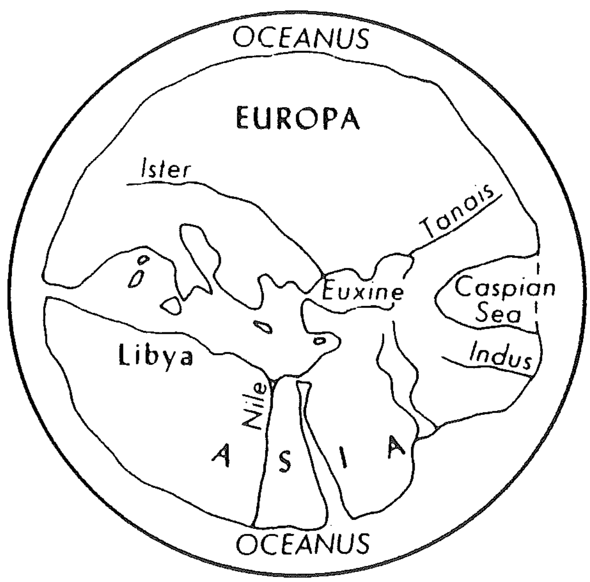


Figure 5.5. Hecateus' interpretation of classical Greek cosmographic thought. Source: Tuan, 1974.

Following urban historian Sibyl Moholy-Nagy, Edgerton argues that the ethnic desire to extend power is the "precondition for orthogonal urban planning" (Edgerton, 1986: 17). In some cases, the grid of the city was extended out to encompass and therefore control neighbouring communities. It could be argued from this that the orthogonal appears to be better suited to the spatial expression of cultural imposition than is the inward-looking circle.

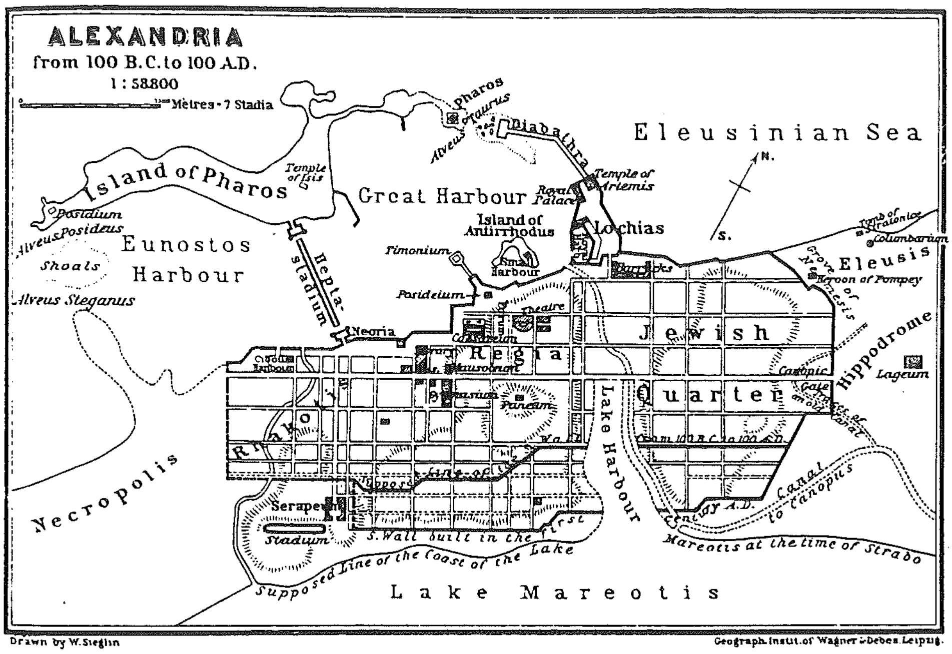


Figure 5.6. Alexandria from 100 B.C. to 100 A.D. Source: Edgerton, 1986.

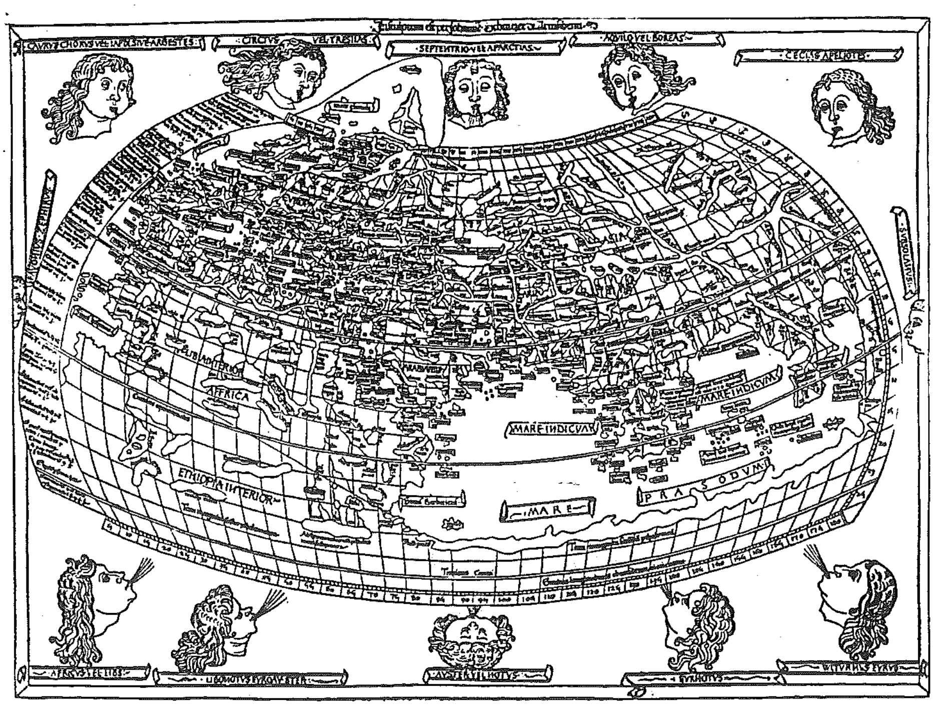


Figure 5.7. Extract from a reproduction of a Ptolemy world map. Source: Bagrow, 1964.

While cartographic historians emphasise the great contributions made by classical Greek cartographers to map accuracy, thus providing the foundation of the science of cartography, they do not examine the cosmological and religious context in which these contributions were made. They make the mistake of looking at these developments in the context of the twentieth century, where science is supposed by many to be objective, uncluttered by religious fantasy. The reality in classical Greek civilisation was quite the reverse, with 'science' and 'religion' firmly interwoven: in fact, science was seen as a way of explaining cosmological belief. Edgerton asserts that

> "...every human society anywhere in the world since the dawn of mankind believed that geometric patterns formed in orthogonal relationships not only pleased the eye aesthetically but possessed talismanic power" (Edgerton, 1986: 11).

Because the orthogonal was supposed to have been divinely appointed, patterns based upon perpendicular lines were believed to contain magic power. That geometry was believed to contain within it a divine as well as a utilitarian imperative is not merely speculation on the part of twentieth-century scholars. Roger Bacon, writing in the thirteenth century, said

> "Since, therefore, the power of geometry is required for the knowledge of every corporeal creature, there is no doubt but that in an inexpressible manner it is effective for sacred knowledge" (Bacon, quoted in Edgerton, 1986: 14).

In many societies mathematics, geometry and thus cartography were seen as integral to understanding the nature of God and how He wished them to order the world.

The circle focused the view inwards, on the self and on one's own community. It excluded others, relegating them to peripheral status. The orthogonal focused the view outwards on to the world, bringing other communities into focus and legitimising conquest and annexation as a divinely inspired 'improvement' to the natural order.

The effect of this change in geometry cannot be underestimated. The grid enabled the Greeks and, following them the Romans, to discover, conquer, annex and exploit to the extent that Europe was turned into "one vast sheet of graph paper" (Woodward, 1987: 4). *The central argument of this chapter is that the history of cartographic form can be summarised as a geometrical transition from the inward-looking circle to the outwardly-focused orthogonal grid.*

However, the initial transition from the omphalos to the orthogonal was relatively short-lived. The period loosely called the 'Dark Ages' was characterised by European retrenchment following the fall of the overextended Roman empire. The majority of the maps drawn in the early part of this period were inspired and sanctioned by the Latin Church, and reflected the inward focus of a church and culture struggling to survive. Figure 5.8 is a schematic representation of the typical T in O maps of the period, where the world as a circle was divided by a simple 'T' device into three regions according to the Biblical account of the sons of Noah. Oriented to the east, these maps had Paradise at the top and Jerusalem at the centre, both significant representations of religious ethnocentrism. Most significantly, the T was drawn within an 'O'; these maps reintroduced the circular form to cartography.

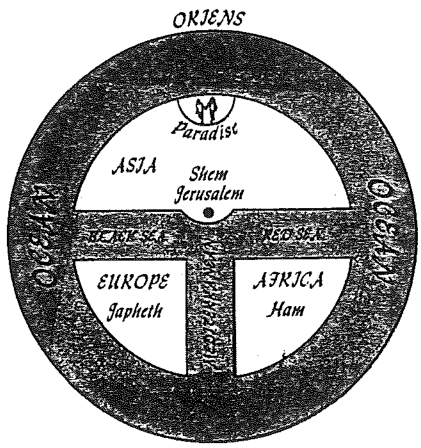


Figure 5.8. The form of a typical T in O map. Source: Prestwich, 1978: 36.

The *Ebstorf mappamundi* (Figure 5.9), drawn in the later period of the Middle Ages, illustrates the omphalos syndrome of an inward looking civilisation. The chart shows Jerusalem at the centre, marked by a patch of gold leaf, and places east at the top, both legacies of the far less detailed T in O maps. Christ's body, of which the Church is the metaphorical representation, is superimposed on the map, so that Jerusalem becomes the navel or centre of the world, the place of origin and primacy. Using this map as a guide, the Crusades can be interpreted as quests to replace the Christian self - the Church, Christ's body on earth - at the spiritual centre of the world. Of all of the world's religions, Christianity was the only one that suffered its geographical centre to be beyond its control. Thus the Church looked inward, only to find itself displaced. The circle was the natural expression of this sorrowful state of affairs. Table 5.1 is a list of the most important maps drawn in this time, according to Leo Bagrow (1964). Significantly, the majority of these maps were based on the circle.

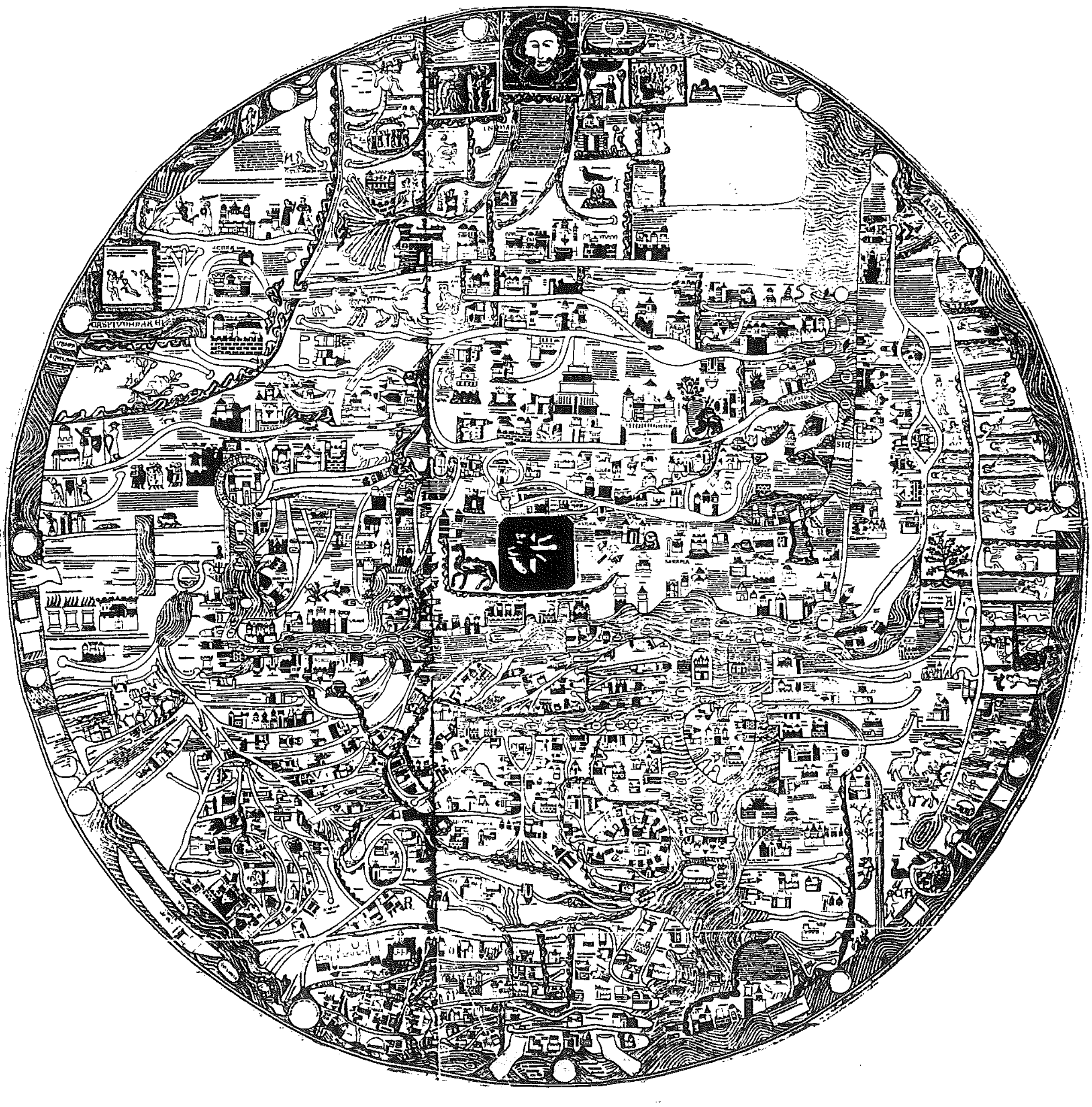


Figure 5.9. The Ebsdorf mappamundi. Source: Bagrow, 1964.

Date of Origin	Name or Author	Shape	Orientation
c. 300	Martianus Capella	circle	N
early VII cent.	Isidore of Seville	circle	E
VIII cent.	Merovingian (Albi) map	rectangle	E
776	Beatus	circle	E
c. 800	Bishop Theodulf	circle	E
late X cent.	Anglo-Saxon (Cottonian)	rectangle	E
XI cent.	Asaph Judaeus	circle	S
1110	Henry of Mainz	ovoid	E
1119	Guido	circle	E
c. 1225	Psalter map	circle	E
c. 1235	Ebstorf map	circle	E
c. 1250	Matthew Paris	rectangle	E
c. 1290	Hereford map	circle	E
XIII cent.	Vercelli map	circle	E
XIII cent.	Wiesbaden map	circle	E
c. 1350	Ranulf Higden	ovoid	E
c. 1350	Johannes Utinensis	circle	S
c. 1370	St Genevieve map	circle	E
1417	Mela-map, Rhiems	circle	E
XV cent.	Wolfenbuttel map	circle	E

Table 5.1. Chronological table of medieval world maps. Source: Bagrow, 1964.

Historical assessment tends to be unfairly patronising of this period of cartographic retrenchment, not seeing that the classical use of the orthogonal was as steeped in cosmological reasoning as was the T in O map. Commenting on developments in the Middle Ages, Prestwich said:

> "Unfortunately, it was not Ptolemy's remarkable achievement which became the model for the medieval cartographers in Europe, but rather the simplistic disc-shaped 'Orbis Terrarum' of the Romans" (Prestwich, 1978: 36).

Ascribing the adoption of the T in O map as a misfortune is a less than accurate assessment of the situation. Ptolemy's cartography was temporarily discarded when the culture from which it came no longer had any use for its most powerful quality, that of imposition. When his work finally reached western Europe the orthogonal became the geometrical imperative of European expansion during the Renaissance and beyond.

Eurocentrism

Ptolemy's *Geographia* was brought to Italy by eastern European scholars searching for original Greek texts. The thinkers of this emerging religious and secular movement known as the Renaissance, while recognising the inaccuracies of the actual mapping, were not slow to see great significance in the work. The grid pattern inherent in Ptolemy's cartography and described in his writing was thought to contain "a clue to the power of God and His master plan of the universe":

> "...the cartographic grid in the Renaissance was believed to exude moral power, as expressing nothing less than the will of the Almighty to bring all human beings to the worship of Christ under European cultural domination" (Edgerton, 1986: 12).

All the ingredients for an impositional cartography now existed within one culture, a culture which saw its divine right and mission as the subjugation of other races and the search for and delineation of knowledge, leading to the reclamation of the world's moral wilderness.

The clearest illustration of this transformation from circle to grid in the Renaissance is found in an illustration more famous than any map, Leonardo da Vinci's *Man in a Circle and a Square* (Figure 5.10). In this prescient drawing da Vinci portrays man as the measure of all things, with geometry being the system of measurement. Using this pure form of mathematics there is nothing that man cannot accomplish. Significantly, this illustration was drawn to accompany *De architectura*, a work by the pagan Roman author Vitruvius. In this work, Vitruvius had suggested that a circle drawn around a man with limbs outstretched would have its centre at his navel (Edgerton, 1986). Da Vinci's drawing illustrates this omphalmic concept.

Da Vinci added something to Vitruvius' work. He owned a printed copy of Ptolemy's *Geographia* and promoted it as "the ideal model for his own treatise on the human anatomy" (Edgerton, 1986: 12). He intended to use the same technique of grid referencing that had been used by Ptolemy to map the world, to 'map' the *minor mondo* of the human body. Using this concept, da Vinci had drawn a square around the man to promote an astrobiological shift from the omphalos or navel as the centre of the circle, the man and the universe to the *phallus* as the centre. Da Vinci here formally authorises the reproduction of the self through the spread of the orthogonal. In the cartographic grid the Renaissance had a figure of great potency with which to fulfil the first ever command: "Be fruitful and multiply, and fill the earth, and subdue it" (Genesis 1: 28). Man was to be outward thrusting rather than inward-gazing. At its most gentle, the activity of European states to reproduce their own values in other areas of the world was impositional in nature. At its worst this reproductive activity might accurately be described as cultural rape.

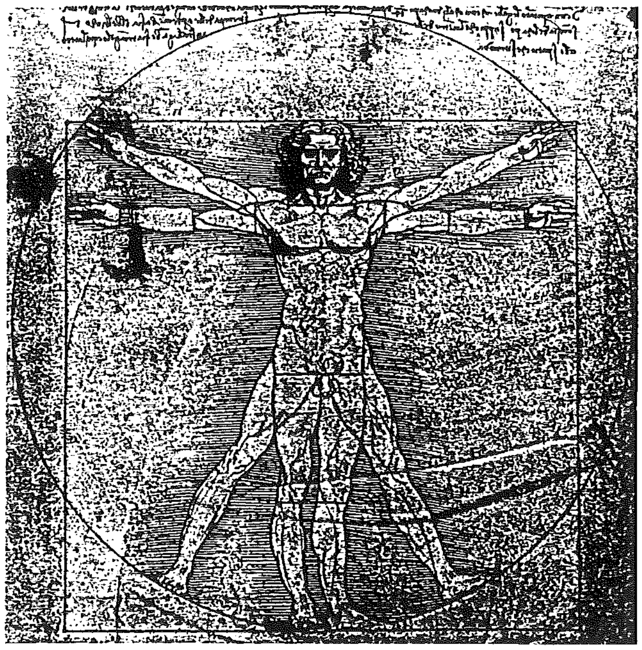


Figure 5.10. Da Vinci's 'Man in a Circle and a Square'. Source: Edgerton, 1986.

The influence of the cartographic grid was immediate and profound. The portolano, sea charts developed by Portugese, Spanish and Italian sailors, contained much knowledge unknown by Ptolemy. His grid system enabled this knowledge to be incorporated in a way hitherto impossible. Much more precise navigation now became possible, and explorers could venture further from their ports. The orthogonal grid was an important part of the spread of European commercial and political influence, and made possible the voyages of Vasco da Gama and Christopher Columbus.

While evangelistic zeal might have accounted for some of the European thrust into the New World, the prime motive for exploration and annexation was economic self-advancement (Overton, 1981). Monarchs and city-states funded maps and explorers for financial rather than eternal gain. With this powerful tool of delineation, the world began to experience a shift from feudalism (of which the city-states were the last manifestation) to mercantile capitalism. Harvey (1984) argues that increased mobility, a direct consequence of the new system of ordering spatial knowledge, led to the requirement for new geographical knowledge. He lists six 'aspects of geographical practice' which characterised the emergence of capitalism in Western Europe, the first of which argued that:

> "Concern for accuracy of navigation and the definition of territorial rights (both private and collective) meant that mapping and cadastral survey became basic tools of the geographer's art" (Harvey, 1984: 2).

Maps were now tools, instruments with which to construct a new world order, first at home and then in foreign possessions.

The Negative Face of Cartography

As defined in Chapter Two, 'face' is the public self-image that every person requires for social interaction. 'Negative face' is the basic human claim to his or her own space, specifically freedom of action and freedom from imposition (Brown and Levinson, 1978). Using this simple analysis one can argue that the new cartography of the Renaissance threatened the negative face of whole cultures: the use of a map to discover, annex, partition and control territory was a face-threatening act that imposed severe restraint on people's freedom of action.

The new form of the map, based on classical Greek geometry as interpreted by Ptolemy and renaissance scholars, was allied with new subject matter to create and enforce new realities. Some of the world's earliest maps had as their subject agrarian property rights, and with the transition from feudalism to capitalism came the need for new maps to quantify the social order in which "the territorial division of land was the basis of status" (Harley, 1988: 285). These maps, the precursors of the modern cadastre, were carefully and deliberately incorporated into a complex system of land law. Combined with the written documents, the large-scale estate maps found in Britain from the sixteenth century onwards enabled landlords, and through them the state, to control a tenant and peasant population. Such an estate map is shown in Figure 5.11. Harley comments:

> "In this portion of Samuel Walker's map of the estate of Garnetts, Essex (1622), details of ownership (DN = Edward Naylor's demense, DL = Richard Lavender's demense, etc.), precise delineation and accurate

measurement (in acres, roods, perches) translate property rights into a tangible and legally binding image" (Harley, 1988: 286).

The boundaries of the fields make up the 'grid' of the map, represented on a legally binding document that constrained the lives of many people while enlarging the domains of a few.

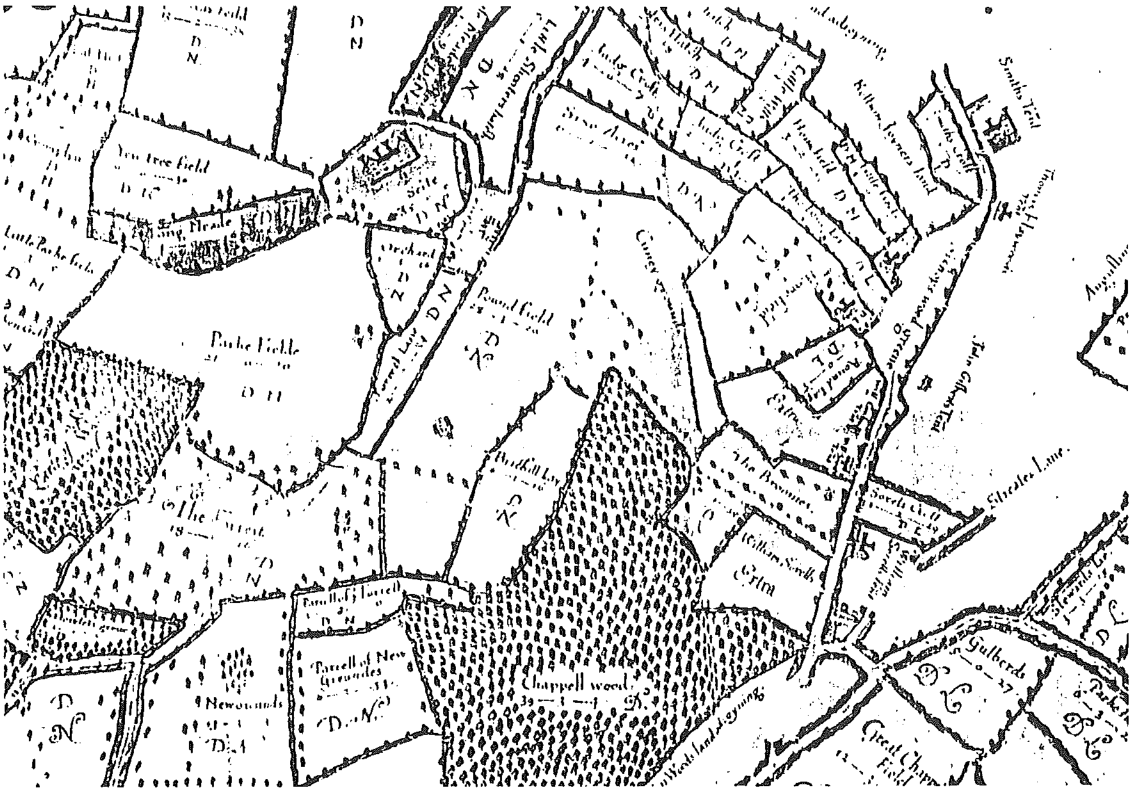


Figure 5.11. The land parceled up. Source: Harley, 1988: 286.

Communication as a legally binding act has been analysed by linguists, by whom the power of a pronouncement to itself create and constrain is called *illocutionary force*. An obvious linguistic example of this are the words "I now pronounce you man and wife", which of themselves are a legal declaration bringing a new marital state into existence. Such simple acts as promises and verbal agreements also carry a degree of illocutionary force. This term can equally be applied to the map as a legal document: as the map decrees, so it becomes in reality. Remove the map, and the reality is legally uncertain.

The illocutionary force of the estate map, and the cadastral map modeled upon it, underlies and legitimises the western notion of land as a commodity to be bought and sold, giving legal force to this particular cultural perspective on the relationship between land and people. Anthony Giddens refers to the capture of power by the creation of *authoritative* *resources* (such as maps) which are controlled by the state (Harley, 1988: 279). These resources are documents of final recourse in the event of dispute, and each one has the measure of illocutionary force necessary to perform its function.

The cadastral grid spread its lines and reference numbers across Europe for the same reason that Alexander the Great's grids swallowed up the classical world: the lines and orthogonals enclosed the domain of others, incorporating it symbolically if not in fact as part of the domain of the self. Because they were dealing with an illiterate population, nobles could be assured that their cartographic legal claims would go unchallenged by the people affected by them. This is the most effective 'face attack' - no-one realises it has happened until the effects are felt. The power structure represented by the estate maps and cadastres relied on individuals in positions of power acting in their own best interests. This is similar in kind to the urban situation Harvey describes in his book Social Justice and the City, where privileged groups are able to adapt to and exploit changes in the legal system, cementing their advantage over the urban poor (Harvey, 1973). The very people who need recourse to the legal system may neither be able to understand its implications nor keep abreast of its changes. The replacement of boundary markers with the property map achieved the same result by concentrating rather than disseminating information and therefore power to act.

Mercantile capitalism became associated with imperialism, in which the state acted to protect its economic interests abroad, and colonialism, in which imperialism is extended to the annexing of foreign territory to secure economic interests. Central to this development was the map with its orthogonal grid. These maps have been potent weapons for imperialist designs, as

> "Surveyors marched alongside soldiers, initially mapping for reconnaissance, then for general information, and eventually as a tool of pacification, civilisation and exploitation in the defined colonies" (Harley, 1988: 282).

The use of maps in this fashion was clearly manifested in British imperialism. Neil Smith explains how geography was influenced by the needs of the Empire:

> "By 1900 the major empire building nations had established distinct national schools of geography within which geographers directed their research to the colonies, the unexplored world... refining their talents as explorers, mapmakers, land-use chroniclers, students of natural

process and artists depicting and describing natural harmony" (Smith, 1979: 371).

The legacy of such a research agenda is still found in the geography classroom. Peter Haggett said recently that "no other [discipline] insists that students include courses on map making, map reading, map projections and the like in the core curriculum" (Haggett, 1990: 8).

At the turn of the twentieth century Sir George Robertson made the claim that geography was "...the science of distances - the science of the merchant, the statesman and the strategist" (Robertson, 1900: 457). A close examination of this claim allows an identification of various aspects of mapping that served the impositional objectives of the British empire.

The Science of the Merchant

People from the three groups identified by Robertson derived most benefit from the cartography of British imperialism. An example of a map used to further the interests of merchants and statesmen is the 'Georgia Scheme', researched by Louis de Vorsey Jr. James Edward Oglethorpe, who supervised the project, is said by De Vorsey to have used maps "carefully calculated to forward the greater goals underlying the genesis of the Georgia Scheme" (De Vorsey, 1986: 35). Originally an 'adventure in social engineering', the settlement of Georgia was aided by mercantile sentiment which presented that part of eastern North America as a "cornucopia of tropical products such as silk, olive oil, dyes, drugs and wine for which Britain was in the habit of paying out large amounts" (De Vorsey, 1986: 35).

Figure 5.12 is the map Oglethorpe and his partner Martyn drew. Both the subject matter and the form of this map are suspect. It shows the area marked as Georgia as a slice of land from the Atlantic to the Mississippi, encased north and south by an arbitrary grid that cuts across existing tribal areas and physical features alike. These boundary lines had been determined by lines of latitude, a totally artificial construct. The most remarkable feature of this map, however, is its silence on subjects of vital importance to potential settlers in this tropical paradise. It was redrawn from an earlier map of South Carolina (Figure 5.13).

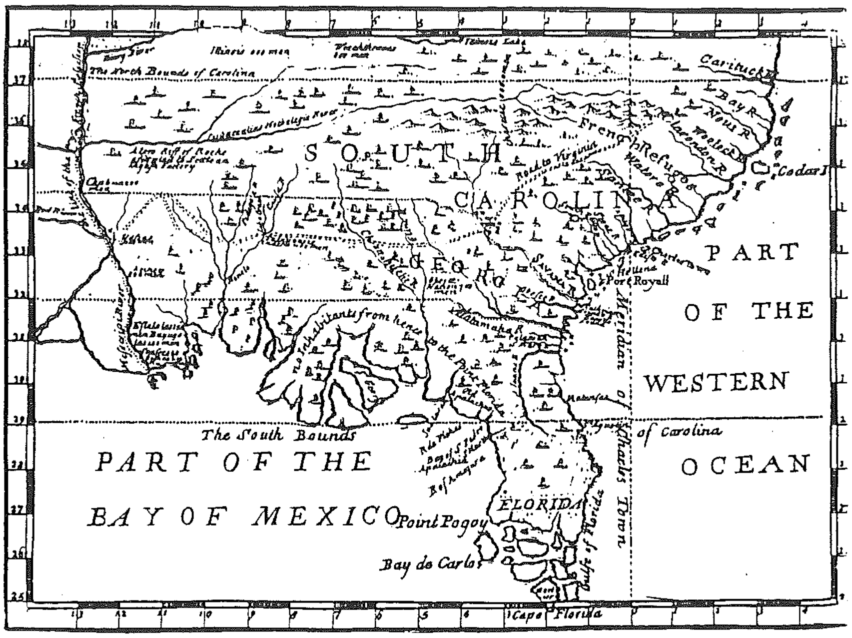


Figure 5.12. Oglethorpe's map of Georgia. Source: De Vorsey, 1986.

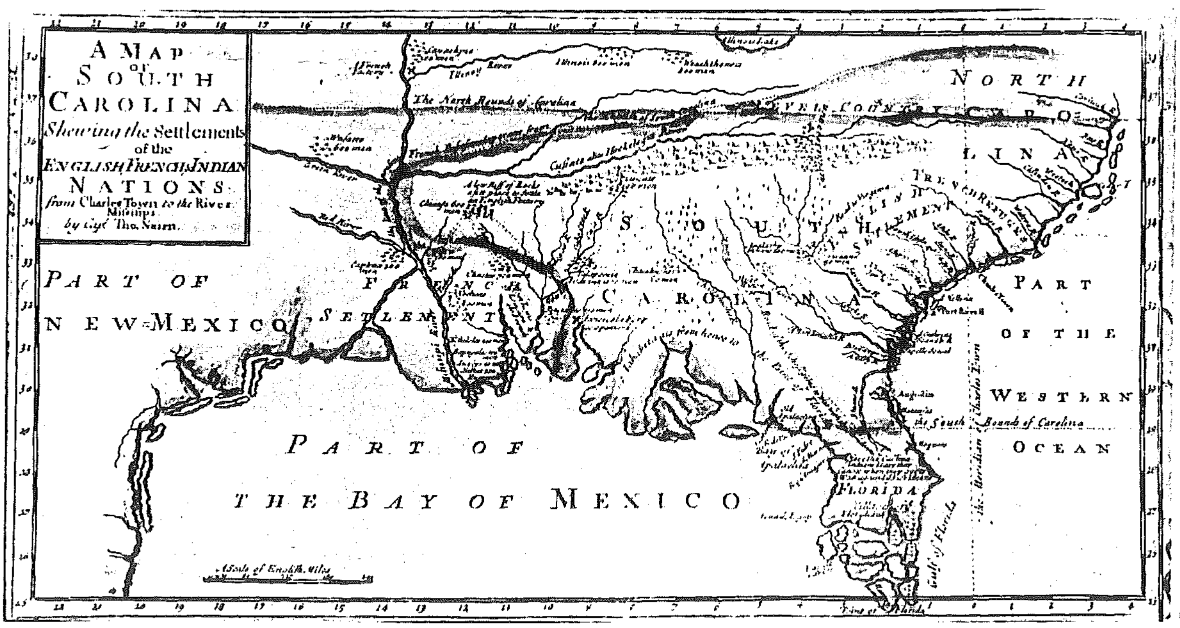


Figure 5.13. Nairne's map of Georgia, from which Oglethorpe's map was derived. Source: De Vorsey, 1986.

When compared with this earlier map, it can be seen that Oglethorpe's map has omitted specific features and textual annotation to create a false impression. Table 5.2 lists these removed features. De Vorsey explains the effect that withholding this information had:

> "The hostile French, whose strategy of expansion and encirclement had been bemoaned by a legion of Carolinians had, with a few strokes, been removed from harm's way to the trans-Mississippi west. So too had the menacing Spaniards at St. Augustine been transported down the coast almost to Cape Canaveral. Oglethorpe and Martyn accomplished with cartography what countless Carolina border raiders and militia had failed to achieve in decades of struggle - frontier pacification in the debatable land south of the Savannah river" (De Vorsey, 1986: 39).

Georgia was, in fact, a buffer between English, French and Spanish interests, all of whom had to contend with the Indian tribes displaced by European settlement and expansion.

Nairne inscriptions deleted from Oglethorpe map
A French Factory
Caphna 200 Men
Cayachpie 300 men
Chicasa 600 Men
Chactas 700 Men
Fort Louis Louisiana 150 French
Chalahuches 80 Men
Pancicolas 150 Men
Pancicola Fort 30 Spaniards
Cusate 100 Men
Apalachy Indians 200 Men
Savanna 150 Men
Yamasee 350 Men
the Road of the Ochese going to war with the Floridians
Here the Carolina Indians leave their Canoes when they goe to War against ye Floridians
Villages of ye Floridians
English Settlement
French Settlement

Table 5.2. Nairne inscriptions deleted from Oglethorpe's map of Georgia. Source: De Vorsey, 1986.

Most of the information on the map is accurate. It is the silence, however, that lends the map its power. In a manner similar to the Ordnance Survey map of Burghfield reviewed in the previous chapter, this map imposes upon the negative face of those who believe its message by removing information vital to their ability to make important decisions. The merchant 'sells' Georgia by using the map as a sales brochure, an occurrence common during colonisation.

The Science of the Statesman

The statesman was often called in at some stage to protect the interests of the merchant, in many cases introducing some form of colonialism. One of the first activities in any newly-formed colony was the commencement of detailed basic mapping, essential for the co-ordination of exploitation:

> "...the surveyor is the pioneer of development; if the country is to be opened up, he must get there beforehand; in general, capital, either in men or means, is not going to waste itself in unknown land" (Report of the British Colonial Survey Committee, 1928: 17; quoted in Balogun, 1985: 159).

Olayinka Balogun's comment on this statement is "it is not surprising, therefore, that surveying was the first professional career introduced into the Nigerian educational system" (Balogun, 1985: 159). This type of education began the process of inculcating capitalist principles into indigenous peoples, in this case teaching them that the world can be divided up into marketable parcels.

What justified such an arrogant, paternal and impositional action by European nations? This thesis attributes such actions to egocentric and ethnocentric attitudes maintained long after they were warranted by the evidence. The explorer, the missionary and the colonist alike often regarded indigenous peoples as inferior. Edgerton suggests a link between these attitudes and geometry:

> "The old notion of synonymy between geometric and moral rectitude was so ingrained in the western mind that people simply took for granted that anyone fortunate enough to be raised in a geometrically ordered environment would be morally superior to those living in the twisted cowpaths of amorphous villages" (Edgerton, 1986: 45).

The map reinforced this moral superiority both as an expression of 'superior' intellect and as a tool necessary for the remaking and renaming of the landscape. Leo Bagrow offers unwitting evidence of the presumed superiority of mapmaking races when he says

> "...an aptitude for drawing is not present in all races, and where such a gift exists it does not necessarily include the ability to draw maps... A primitive savage's drawing is often like a child's; the object engaging his attention is placed in the foreground, large and unconnected to other objects around it. Neither child nor savage immediately observes perspective" (Bagrow, 1964: 25).

Such beliefs allowed moral and intellectual superiority to evolve into a manifest destiny, in which the builders of empire claimed a right to the resources of the world:

> "Shall we English who inherit so large a part of the world not acquaint ourselves with our inheritance and the conditions under which we can retain and make the most of it?" (Freshfield, 1886: 701).

An example of a map expressly drawn for such a purpose is that produced by Arthur Silva White for the Sixth International Geographical Conference, held in London in 1895. This map is shown in Figure 5.14. In his accompanying article White makes the purpose of the cartographic exercise quite clear.

> "My map (prepared in 1891) illustrates in a graphic manner what in my opinion, is the relative value of African lands to the European Powers having control over them... In estimating the comparative value of African lands, my standpoint has been that of the European diplomatist... All humanitarian motives may be set aside as not being pertinent to the present inquiry" (White, 1895: 579).

The value of these lands is largely determined "by the capacity of the suzerain or dominant Power to make use of them" (White, 1895: 579).

This use was often quite different to that which indigenous peoples had used the land for centuries. While malice may not always have been intended towards these native inhabitants, attitudes such as those expressed by Colonel Sir Thomas H. Holdich, president of the Royal Geographical Society, effectively served to disenfranchise them:

> "The right of the white man to fill the earth and subdue it has always been unquestioned, because it is based on the principle that his dominance and lordship tend to the betterment of the world and *straightens out the highways* for the peace and the blessings of civilisations to follow" (Holdich, 1917; quoted in Smith, 1979: 371. Emphasis mine).

It should be apparent how closely this statement reflects the argument advanced thus far, that by straightening out the world one improves it. A better illustration of the parallel hegemonies of Europe and the orthogonal could not be found.

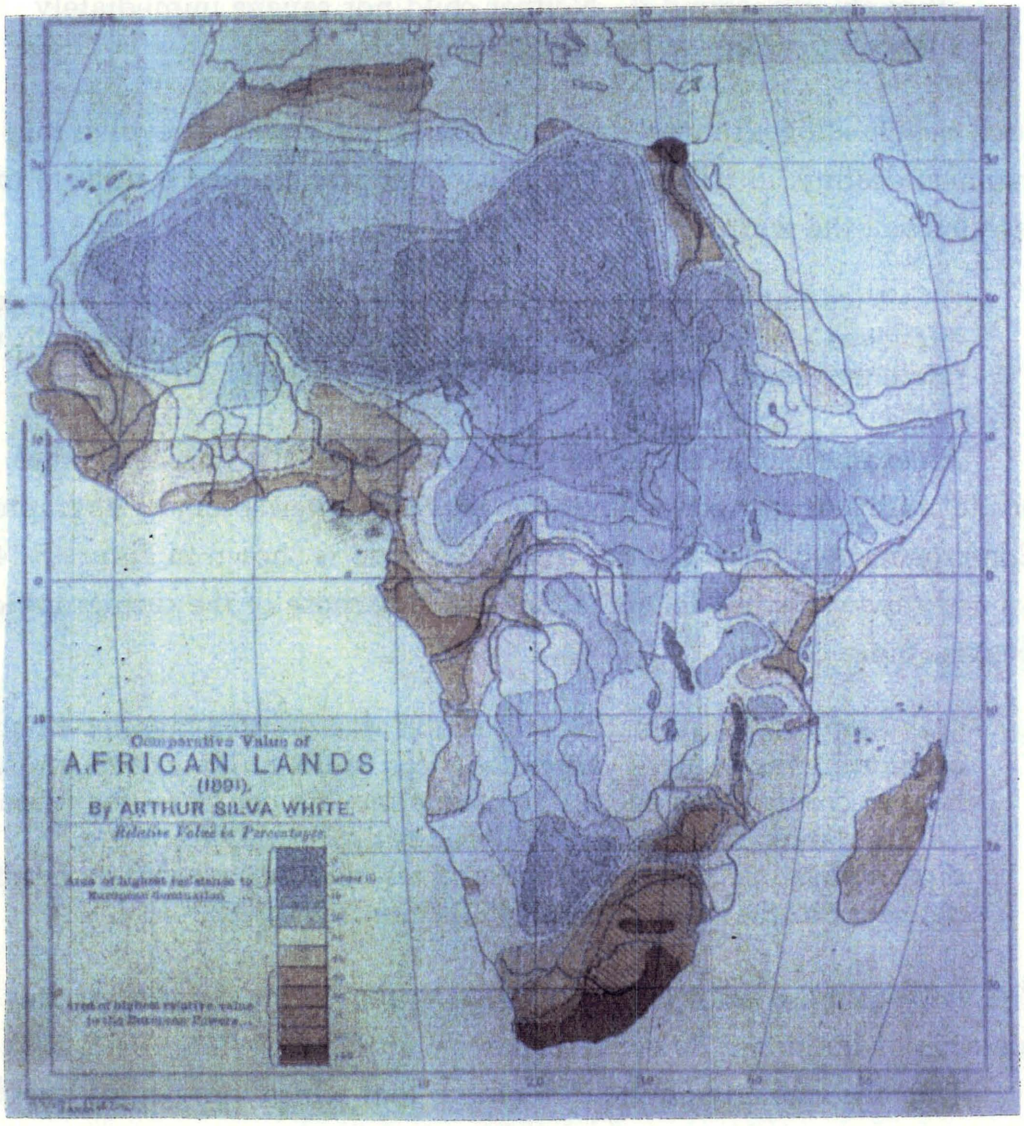


Figure 5.14. The comparative value of African lands. Source: White, 1895.

Colonisation saw Ptolemy's orthogonal grid imposed upon the earth in a manner and with an intention strikingly similar to the operation of a botanist's quadrat. Lines were drawn on maps that followed parallels and meridians with little or no regard for the lives of the prior inhabitants (Sack, 1986).

Nowhere was this more clearly illustrated than in the partitioning prior to the independence of Britain's greatest colony, India. Sir Cyril Radcliffe, a lawyer specifically chosen for the job because of his lack of knowledge of Hindu-Muslim grievances, was set the task of dividing India into two countries on the basis of religion. His lack of knowledge was supposed to guarantee his impartiality. He had thousands of kilometers of boundaries to determine in a time frame of a few short weeks, which "compelled him to demarcate on average 30 miles of frontier every day" (Collins and Lapierre, 1972: 212). Instead of being able to walk through the land his lines were to mutilate, Radcliffe could only sit in a hut and draw with pencil on a ludicrously large-scale Royal Engineers' map. He was forced to visualise the impact of his work on areas that seethed with life, as he unknowingly divided communities from the crops they grew, crops from their processing factories, factories from their freight depots, depots from the towns they served and towns from the country of their religion. For example:

> "The line in the Bengal condemned both parties to economic ruin unless they could collaborate. Eighty-five per cent of the world's jute was grown in the area that had gone to Pakistan, but there was not a single mill for processing it in the new state's territory. India wound up with over a hundred jute mills, the port of Calcutta from which it was shipped to the world - and no jute" (Collins and Lapierre, 1972: 280).

The rude pencil marks even divided houses in two, with a door opening to Hindu India and a window looking out over Muslim Pakistan. Within hours of the official announcement of the boundaries, former countrymen and neighbours were killing each other in their thousands, with minority enclaves suffering genocide (Collins and Lapierre, 1972). Lines on maps are not simply an esoteric cartographic concern. In this stark case of illocutionary force the map decreed "the lives and deaths of millions of people" (Harley, 1988: 283).

The Science of the Strategist

The strategist was called upon to defend home territory or map enemy territory prior to invasion. Many western countries began their national topographic surveys in response to the needs of the strategist (Hodgkiss, 1981). This is confirmed by Harley:

> "...throughout the 18th century, it was military departments of state in most European countries who were the main consumers for the products of official surveys. The use of topographical maps to aid the tactical movement and manoeuvres of armies was an established practice" (Harley, 1978: 165).

Topographical information was essential to field commanders and backroom planners alike: altitude, vegetation, cultural features and hydrography all had to be located within an extremely precise grid. Strategists were provided crucial information on infrastructure, communications, battle sites, line-of-sight for artillery fire, location of vital installations, cover for approach and ambush, and population centres.

Britain's national topographical mapping coverage, conducted by the Ordnance Survey, is a case in point. The origins of this body can be traced back to the eighteenth century, when the military survey of Scotland was conducted. Organised by William Roy, this survey was undertaken in response to the highland rebellion of 1745 and gave the English the detailed knowledge of the highland glens they required in order to counteract the advantage that local knowledge conferred on the highlanders. The survey itself, and the maps it produced were used to keep the rebels in order and to encourage the spread of enclosure (Millman, 1975; Harley, 1978).

Using this survey as a precedent, Roy lobbied for a nationwide topographic coverage of Britain after the manner of the Cassini survey of France, proposing in 1763 "to make a general survey of the whole island at the public cost" (Harley, 1978: 164). His argument for this use of public money ran as follows:

> "Accurate surveys of a country are universally admitted to be works of great public utility, as affording the surest foundation for almost every kind of internal improvement in time of peace, and the best means of forming judicious plans of defence against invasions of an enemy in time of war" (Mudge and Dalby, 1799; quoted in Harley, 1978: 169).

Although Roy's suggestions were not acted upon until the time of his death, there can be no doubt that his argument eventually convinced the authorities to spend the money required for an accurate trigonometrical survey.

An examination of the man William Roy helps explain why he, and his patrons, would conceive of such a project primarily as a military subject and in geometrical form. Harley sheds some light on Roy's thinking by saying that

> "The military element in Roy's life was the indispensable background to his cartographic achievements and to it can be traced many of his ideas about topographical mapping, as well as the administrative shell to which a government survey would eventually be attached" (Harley, 1978: 165).

Recruited in 1752, Roy had become a Major-General by 1781. An examination of the sale documents for his personal library as it stood after his death showed that

> "...he was deeply read not only in military science...but also in the theory of mathematics and survey as they related to geodesy, and in the background to the antiquities of Roman Britain" (Harley, 1978: 164).

The ideas of William Roy were directly descended from the Renaissance, and were founded in the thinking of classical Greece and the order of ancient Rome. Once a person recognises that "in his cartographic art he possesses an instrument of thought of no mean power" (Mackinder, 1895, quoted in Wise, 1975: 13), it is but a small step to turn that potential into reality, a reality that directly serves not the general public but the strategist. It should be clear that the subject matter and the form of the topographic map were not designed with the general public in mind.

Petchenik notes that "part of the driving force for topographic mapping has always been the need for maps for defence and military use" (Petchenik, 1985: 15). While most countries made their topographic maps available, those generated by military organisations are often much more difficult (if not impossible) to obtain. Harley notes:

> "Cartographers provide the state with a mass of information which the state, from its strategic position, is able to exploit. Moreover, the state was also frequently able to impose its own rules upon this cartographic knowledge, giving rise to the silences that are induced by those occasions of deliberate secrecy and censorship that recurs so often in the history of European state mapping" (Harley, 1988: 59).

An example of censorship for military reasons has already been presented, (Figures 4.3 and 4.4). Having been regarded by many authors as a 'reference' map, by nature an objective representation of the surface of the earth, the topographic map is revealed to be as closely influenced by the wishes of generators as have any of the maps presented in this discussion.

Conclusion

The development of cartography has been dominated by geometrical revolution predicated on religio-scientific (cosmological) belief. The circle was the most natural expression of egocentric and ethnocentric viewpoints, but was discarded in favour of the orthogonal to turn maps into an impositional device. The Renaissance saw the full flowering of the transition from the omphalmic circle to the phallocentric orthogonal, where lines and grids have been imposed upon the globe to measure it, know it and order it with increasing accuracy. This is as much a 'biased' representation of the way things really are as were the ancient T in O maps.

Individuals such as Da Vinci and Roy interacted with the state to both confirm and extend the historical social context in which they lived. The map has required two conditions to traverse its history: the social context of self-centeredness, as expressed in egocentrism, ethnocentrism and eurocentrism; and enterprising, opportunistic or empowered individuals to generate maps based on the advantages of that social context.

The arguments presented in this chapter do not pretend to be a comprehensive review of the history of cartography. Their function has been to show that the form of maps throughout history has reflected the use to which they have been put. Chapter Six continues this theme, identifying aspects of contemporary map form that have their origin in the purposes of map generators.

Chapter Six

The Present Condition of Cartography

Introduction

The subject matter of the maps produced in contemporary society is only a small subset of that which is mappable. Moreover, the form that these maps take is likewise limited when compared to possible ways of mapping. This chapter shows how map generators, having control over the subject matter and form of maps, have constrained the map for their own purposes. The discussion highlights the adverse effect of this impositional mapping policy on maps users.

The discussion is structured as follows. The main thrust of the previous chapter, which was the developing cosmological significance of the geometry of maps, will be traced to the present day in the first section which deals with the insistence upon accuracy in modern mapping. This insistence is argued to be an attempt by humankind to control the earth. The reasons for such a cartographic programme are examined in the second section, where contemporary cartography is seen as assisting in economic and social development of the kind which advantages some groups over others. The impact of this situation on map users is the subject of the third section. Discussion is linked to the notion of targeted and non-targeted users presented in Chapter Three, and shows that the emphasis on map accuracy may satisfy a few users while acting as a barrier to many more potential users of maps.

The Pursuit of Accuracy

The Historical Development of the Need for Accurate Maps

The very existence of maps can be argued to represent an attempt to control the natural and social world. The effect of shrinking the sphere of the earth, compressing it to fit on a small diagram, is to enlarge by comparison the human sphere to encompass the earth. Thus Hannah

Arendt could write "nothing can remain immense if it can be measured" (Arendt, 1958: quoted in Wilford, 1981: 23). This is semantically true, for 'immense' means 'without measure'. It is also metaphorically true in the case of cartography. Commenting on Eratosthenes' achievement of accurately estimating the circumference of the earth, John Wilford said "it was Eratosthenes who first... condens[ed] the size of Earth from unknown immensity to a measured dimension" (Wilford, 1981: 23-24). To measure the earth, to encompass it, makes the earth manageable.

In order to place accurately the cartographic grid upon the map, and to devise accurate map projections, the value of a degree of latitude had to be known precisely. Much effort went into gaining this measurement: in 1525, for example, Jean Fernel used his carriage wheel as an odometer to measure the length of a degree, improving a little on Eratosthenes' measurement. The French efforts towards geodetic accuracy continued with the Cassini survey of France, where they discovered systematic discrepancies in their triangulation measurements which led them to suspect that the earth was not, in fact, a perfect sphere. With the authorisation of Louis XV, the Royal Academy of Sciences mounted two geodetic expeditions to measure the length of a degree of latitude at the Equator and at the Arctic Circle. The expense and difficulty of the exercise was justified by the leader of the expedition to Lapland, who wrote in 1736 that "The Advantages arising from the Discovery of the Earth's true Figure, go beyond mere speculation; they are real, and of very great importance" (Maupertuis, quoted in Wilford, 1981: 101). This importance was summarised by Wilford, who states:

> "The framework of any map is derived from a knowledge of the size and shape of the entire Earth and from measurement of the length of a degree along a meridian" (Wilford, 1981: 110).

People other than scientists perceived advantages in map accuracy. Louis XV of France was said to have remarked "that he lost more territory to good maps than he ever gained by advancing armies" (Southard, 1983: 5). This writer continues:

> "... to him and to other pre-Industrial Age monarchs, mapping was nothing less than the identification, measurement, and description of the physical characteristics of state sovereignty" (Southard, 1983: 5).

When heads of state realised the significance of accurate delineation of territory, both in preservation and annexation of their possessions, they invariably moved to sponsor, and thereby generate, accurate mapping. Wilford outlines the effect this had on the map makers:

> "The pursuit of accuracy transformed the character of mapmaking. Cartographers left the printing shops and the cloisters and went into the field. They fanned out, soldiers and adventurers, navigators and scientists, to survey the land and the sea. Their surveys helped define the known and encompass the unknown" (Wilford, 1981: 110).

A combination of genuine error and expedient inaccuracy rendered most cartographic products grossly imprecise until the early nineteenth century, when instrumentation had improved to the point where the raw data collected was of a similar standard to the techniques of manipulation. It is important to note that at this time a belief developed in the efficacy of a link between accuracy and knowledge. Many writers claimed that something was not truly known until it was quantified:

> "When you can measure what you are speaking about and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre, unsatisfactory kind" (Lord Kelvin, quoted in Maling, 1989: v).

This statement reflects the development of positivist science, in which the empirically measurable is favoured over the subjective, as discussed in Chapter Two. The idea that knowledge needed to be enumerated before it could be useful helped confirm the role of the map as a repository of a great deal of accurate information.

Much effort went into enumerating the data required by map generators so that navigational routes, property and administrative boundaries, physical topography and graticules were all accurately described. These types of information dominate map content. Cartographic and geodetic techniques have developed in response to the need for precise delineation of these specific types of information. These techniques now dominate cartographic form.

Cartometry, The Science of Cartographic Accuracy and its Use

Cartometry is defined as "measurement and calculation of numerical values from maps" (Maling, 1989: 1). While one must be careful to distinguish these from the techniques used to map phenomena in an accurate fashion, cartometry is still representative of the contemporary focus on quantitative values in spatial representation and interpretation. Such techniques encompass the four types of map measurement that make up cartometry:

1). Distance measurement;

2). Area measurement;

3). Measurement of direction; and

4). Counting the number of objects shown on a map (Maling, 1989).

Cartometric principles have scientific, administrative and route-finding applications. These three uses of accurate cartographic measurements served the three major historical sponsors of cartography; the merchant, the statesman and the strategist. Contemporary cartography reflects its historical antecedents.

The definition of accuracy as applied to maps is not straightforward, and Maling (1989) groups the definition under three headings, as follows:

1). *Positional Accuracy.* "The closeness of location of points of map detail to their true ground positions, each measured with respect to the same grid or graticule" (Maling, 1989: 145).

2). *Qualitative Accuracy.* Correctness (where possible) of qualitative information such as place names, identification of features, spot heights and boundaries of features such as forest cover, much of which requires qualitative judgement during deconstitution.

3). *Completeness.* The reduction of information by selection and generalisation to the point where the map does not fulfil the purpose for which it was designed is an example of an incomplete map. Maps may be fully incomplete (insufficient information over the whole map area) or partially complete.

Maling suggests that, from the point of view of what he calls the 'general' map user (as distinct from the 'serious' map user), the first form of accuracy is less important than the latter two:

> "If the map shows the inn and the church and the path across the fields between them, this information will probably satisfy the user, who is more likely to criticise the map if the inn proves to be a church, or if the path is not shown, than for the reason that the distance between the buildings measured on the ground does not agree with that scaled from the map" (Maling, 1989: 146).

In spite of this, cartographers have consistently emphasised *positional* accuracy. One can hold in one's hand a map meeting exacting standards of positional accuracy yet containing glaring qualitative and completeness errors. The effect on map users of this focus on positional accuracy is explored in the last section of this chapter.

Much of the ostensive information provided in maps is found around the map border. It is here that the user looks for scale and orientation information, as well as reliability details and other aspects of the map's construction. The information contained within the map border often reflects the message of the map. This is true of Figure 6.1, where the Mercator projection is deliberately used, outside of the navigational context for which it was designed, to show the areal extent of the British Empire. Centred on Europe, the map conveys an impression of a dominant world power, an impression emphasised by the sprawling pictures bordering the map. Britannia sits atop the world, ruling her subjects with the authority that domination of the seas confers upon her. The map acted to reassure privileged members of the Empire of their status and their possessions.

Figure 6.1. Britannia Rules the Waves. Source: Drabble, 1978.
Originally a supplement to 'The Graphic', July 24th 1886.

Modern marginal cartographic information serves a similar purpose. It is the ostensive message of the map, inviting the map user to pay attention to the accuracy of the map. It speaks of an advanced nation, sufficiently developed to sponsor its own national mapping coverage. It conveys the impression of a technological power, ruling her subjects with the authority that the graticule confers upon her.

The very notion of accurate maps can be used to enhance national prestige. The head of graphics of what was known as the New Zealand Tourist and Publicity department (NZTP) explained to the present author in 1987 that the department was no longer producing 'fun maps' (his designation for pictorial-style maps), even though they were acknowledged to be easier for tourists to interpret. Fun maps, he explained, suggested a third-world country short on technology, while detailed maps of a more accurate kind communicated an image of a country sufficiently developed to cater for the sophisticated tourist NZTP was now targeting. This policy was pursued even with the explicit knowledge that fewer people were likely to interpret the detailed maps correctly (personal interview, 22 May 1987).

The pursuit of accuracy is a cosmological statement about faith in technology and its ability to order the world. The imperative is secular rather than religious; as Harvey points out, the secular imperative was different in that

> "... space and time had to be organised not to reflect the glory of God, but to celebrate and facilitate the liberation of 'Man' as a free and active individual, endowed with consciousness and will" (Harvey, 1989: 249).

The domination of nature, including the conquest and rational ordering of space, is an important part of the liberation of 'man'. Here lies the great usefulness of accurate maps: they assist in the straightening out of the world.

The Importance of Mapping in a Modern Society

Advocates of national mapping coverage insist that it is ~~in the~~ 'national good' for the state to manage the provision of comprehensive topographic and cadastral base mapping. "The map is a tool employed in all spheres of activity of a nation. Therefore, it is the obligation of the state to undertake the task of furnishing the most useful and adaptable tool"

(Laferriere, 1971: 583). This view is endorsed in a publication from New Zealand's official mapping Department:

> "Survey and Land Information inherit certain national and international responsibilities and activities from which the whole country benefits" (DOSLI Bulletin, 1 April 1987).

These responsibilities proceed directly from historical government objectives, self-defined as "the survey and disposal of Crown land to encourage settlement of the land and development of the nation" (Hawkey, 1986: 6). The assumption that forms the basis of such statements is that mapping is in the national interest.

More explicitly, that part of the mission of the Department of Survey and Land Information relevant to mapmaking is defined by statute as follows:

> "To authorise, integrate, and extend the survey and mapping systems supporting secure tenure:
>
> To ensure the provision of topographic, cadastral, and other land data bases to adequate standards for the efficient administration, enjoyment, and development of the resources of New Zealand" (Survey Act 1986, No. 123.4 b and c).

Two of the major purposes of modern maps are expressed in this mission statement. The first is mapping as a means of control: western capitalist social structure depends upon secure land tenure and efficient administration. The second purpose is mapping for development: topographical and cadastral data form the base for almost all New Zealand mapping, public or private, that is designed to exploit the country's resources.

A third type of mapping to be examined extends the discussion to map images not generally recognised by cartographers as 'true' or 'real' maps, and can therefore be called *non-metric* mapping. These map images exist to persuade their audience of the validity of one specific message. In this category is included fun maps, sketch maps, and schematic maps; in fact all map images without a mathematic foundation. These three types of mapping will be examined in turn.

Mapping as a Means of Control

At a 1979 international conference of surveyors, the then head of the Ordnance Survey, Walter Smith, outlined the major reasons why, in his opinion, national mapping should remain a function of government. He pointed out that

> "National mapping derives from government its responsibility to ensure order and to foster progress. National mapping helps to ensure order... by the rearrangement of some individual rights and resources in the common interest of maintaining national order and secure administration" (Smith, 1980: 78).

A major purpose of mapping in contemporary society is as a means of controlling that society. 'Control' is implied by the use of such terms as 'order', 'administration' and 'security'. J. Andre Laferriere, in a paper entitled "The Importance of Mapping in a Modern Society", argued for state funding of basic mapping because, in his words, "The map is both an instrument of investigation and a means of control" (Laferriere, 1971: 582).

The use of maps in this fashion can be traced directly from their historical development as tools of imposition, as discussed in the previous chapter, where it was shown that topographical and cadastral surveys were instrumental in the annexation, partitioning, defence and control of both home and colonial territory. Smith's suggestion that to ensure order it is required to 'rearrange some individual rights and resources' is a face-threatening act enforced by the illocutionary force of legal documents, including maps.

The development of Geographical Information Systems (G.I.S.) introduces a more effective level of cartographic state control over people and resources. A G.I.S. "embodies the means to capture, manage, analyse and display spatial information" (Forer, 1989: 1). In terms of the MUGs model introduced in Chapter Three, G.I.S. can fulfil virtually all the tasks that fall to the map maker, making them systems of deconstitutive and reconstitutive power. Much has been hoped of such systems: "today, the digital revolution is changing the meaning of the word 'map' and further broadening the audience for spatial data" (McCormack, 1987: 299) and "... the ability merely to plot a 'good looking' map will become as common-place as the ability to type a 'good-looking' letter" (Monmonier, 1985: xvii) are but two of hundreds of positive comments elicited by the promise of such systems.

Monmonier (1985) develops some issues of concern relating to the use of G.I.S. His first concern relates directly to the freedom of the individual, and he writes that G.I.S. are "... possible instruments of excessive government control" (Monmonier, 1985: 185). Secondly, and related to this, is the potential for suppression or distortion of information by the keepers of the system. Numerous precedents for this kind of activity exist in cartographic history (Harley, 1988). Thirdly, he suggests that reliance on G.I.S. might lead to an over-dependence on quantitative rather qualitative data in decision-making, dehumanising such decisions. A further important point raised by Monmonier and by others (McCormack, 1990) is the limiting of access to what used to be free or inexpensive information. This restricts the technology to elite groups because of cost and expertise:

> "Most G.I.S. to date... have been clearly targeted at professional elites, principally in defence, mapmaking, planning and research. This has been reflected in the hardware base, user interface, prime functionality and capability of such systems" (Forer, 1989: 1).

Because the needs of these elites have remained unchanged in kind (if not in degree), G.I.S. has accomplished little in terms of innovation, in spite of its potential. Digital mapping equipment has been employed to produce conventional maps more quickly (Blakemore, 1985) rather than an investment in systems capable of alternative spatial representations. Computer-assisted cartography perpetuates the prime function of maps as instruments of social and environmental control. Forer laments the fact that "... current G.I.S. represents an inherent conceptual conservatism in what is ostensibly a fast-changing and revolutionary technology" (Forer, 1989: 1). This is amplified in a more recent paper, where the writers clearly link conceptual problems with G.I.S. to problems in cartography as a whole:

> "... without exception, the underlying philosophy of such systems is based on quantitative, positivist analysis. Roots in surveying and map production have emphasised the mensurative aspects of spatial data. Interestingly, in spite of the radical nature of many hardware platforms, the resulting cartography is conservative" (Forer *et al*, 1990: 2).

The subject matter of G.I.S. is more likely to be influenced by map generators than any other type of cartographic endeavour. Forer has noticed that this subject matter has a common theme "embedded in a context of control or planning functionality" which "... perpetuate rather than modify many of the modes of thought which have accompanied paper-based mapping systems" (Forer, 1989: 3).

Undoubtedly, G.I.S. as a concept has great potential. It is the application of this concept in a society that advantages those who can purchase and control information (and, with it, aspects of that society) which is of concern to the critics cited above. The potentials of G.I.S. form part of the discussion in Chapter Eight, in which the development of a computer-based alternative cartographic system is explored.

Mapping for Development

At the root of twentieth century society is the idea of development. Expressed by Pepper (1984), developmentalism is the ideology arising from the belief that material and social goals are best obtained through progressive resource exploitation. This ideology is reflected in the economic practices of poor and wealthy countries alike, forced upon them by the nature of global capitalism as it is presently formed.

Mapping can be found at the centre of much contemporary economic activity. For the following reason a significant amount of this cartography is sponsored by the state:

> "It is now acknowledged that a regular topographical survey, far from being a luxury, is an essential preliminary for sound development, and therefore an economy in the long run" (Crone, 1953: 160).

Economic development is not usually the prime motivation for the institution of national mapping programmes. This sort of mapping is motivated for administrative and military purposes. However,

> ""A topographic map prepared for purposes of internal security and defense may also be used for private economic progress, such as energy and natural resource development" (Southard, 1983: 6).

Those involved in economic development and commercial ventures identify maps as necessary for the location of resources and as aids to decision-makers. "Cartography and basic mapping always constitute the first phase of all development (Laferriere, 1971: 585). When used effectively, spatial information provides an economic return far in excess of the outlay required to procure it.

The *national atlas* is an example of both the promotion and enhancement of national economic and social development. New

Zealand's first national atlas, A Descriptive Atlas of New Zealand (1959), was described in its foreword by the then Prime Minister as being, "in a sense, an analysis and assessment of New Zealand's resources" (McLintock, ed., 1959: foreword). This analysis and assessment is a necessary prelude to development:

> "Man must make an inventory of materials, classify them, know their geographic location, their accessibility, their utility in the order of needs and their potential in economic growth" (Laferriere, 1971: 583).

In a review of the successor to this atlas, the New Zealand Atlas, Garth Cant remarks upon the image projected by its content:

> "The overall effect is to present an 'open country' New Zealand, one which is varied, rugged, always beautiful, sometimes agricultural and one where cities and men occupy an infinitely small space... In contrast to its physical environment and landscape the people of New Zealand emerge as faceless, colourless and static" (Cant, 1976: 2-3).

This is the natural result of a focus on physical resources, then perceived to be the ingredients of development.

Users of the Atlas of Britain (1963) were expected to be administrators, industrialists, teachers, agriculturalists and research workers. The Philippine Atlas (1975) was to be used by government technocrats, professional managers, foreign investors and student researchers. The prospective clientele of the National Atlas of the United States of America (1970) were a similar constituency: the atlas was designed to be "of practical use to decision makers in government and business, planners, research scholars and others..." (Pecora, 1970: vii). Planners, decision-makers and researchers clearly recognise the importance of a comprehensive and accurate mapping resource as an aid to economic development. Use of the large scale national atlases enables the identification of potential development projects and problem areas, while large-scale maps can be employed to solve those problems and to plan specific development. Moreover, these atlases are produced to promote the nations that sponsor them, and as such are often one-sided: "national atlases may have propaganda functions both within and outside a nation's borders, and cartographers and governments are aware of them" (Kent, 1986: 123).

A report by an 'international committee of experts on cartography' presented to the United Nations Department of Social Affairs in 1949 outlined the centrality of mapping to the process of development. In order to plan for development, they argued, many kinds of information needed to be collected and displayed (such as is done in a national atlas) on a topographic base. Because of this, the committee concluded their report by saying "Topographic mapping is, *par excellence*, a public service and therefore a function of government" (U.N. Dept. of Social Affairs, 1949: 14).

While the public are provided with this service, at no stage are they able to influence what is to be mapped and for what purpose. As long as governments continue to entertain the notion of progressive resource development, no possibility apparently exists of deviation from the ideology of developmentalism and its cartographic expression. The acceptance of this ideology by third world countries makes them vulnerable to exploitation, as the development of large-scale projects (such as dams and mineral extraction) continue to move funds offshore while exploiting a largely indigenous labour force. Moreover, the materialistic values reflected in this type of mapping are imposed upon the country which accepts outside assistance. In 1987 it was reported that

> "Survey and Land Information people are currently working on a project in Fiji to rationalise, integrate and update their system of survey, land tenure recording and mapping" (DOSLI Bulletin, April 1 1987).

The survey system being updated in Fiji is of colonial rather than of indigenous origin and reflects values initially imposed from abroad upon Fijian culture. New Zealand support of this project may help to entrench within Fijian society the values upon which it is based. Much attention has been focused on the role that those who control resources play in promoting unequal development (Harvey, 1977; Peet (ed.), 1980; Forbes, 1984), yet few have questioned the use made of tools that have been fashioned to facilitate this control and unequal development.

The present author has uncovered a local (Christchurch) example of cartography used to further developmental aims while imposing upon its audience. The maps in question are associated with the widening of Fendalton Road, an arterial traffic route running through the city's most affluent suburb. The location of this scheme is shown in Figure 6.2. A local government planning initiative, the Fendalton Road Widening Scheme caused controversy and polarised opinion with regard to what, if any, option for development ought to be pursued.

Pressure to have the road widened came from a number of sources. In 1987, the time of the controversy, the urban area was administered by a number of local authorities. Somewhat over half of the population of

300,000 came under the aegis of the Christchurch City Council, while a large proportion of the remainder lived within the boundaries of Waimairi District. A regional body, the Canterbury United Council (CUC), co-ordinated certain activities of these local authorities. Although the city end of Fendalton Road is within two kilometers of the city centre, the road lay wholly within the area administered by the Waimairi District Council (WDC), as shown by Figure 6.2.

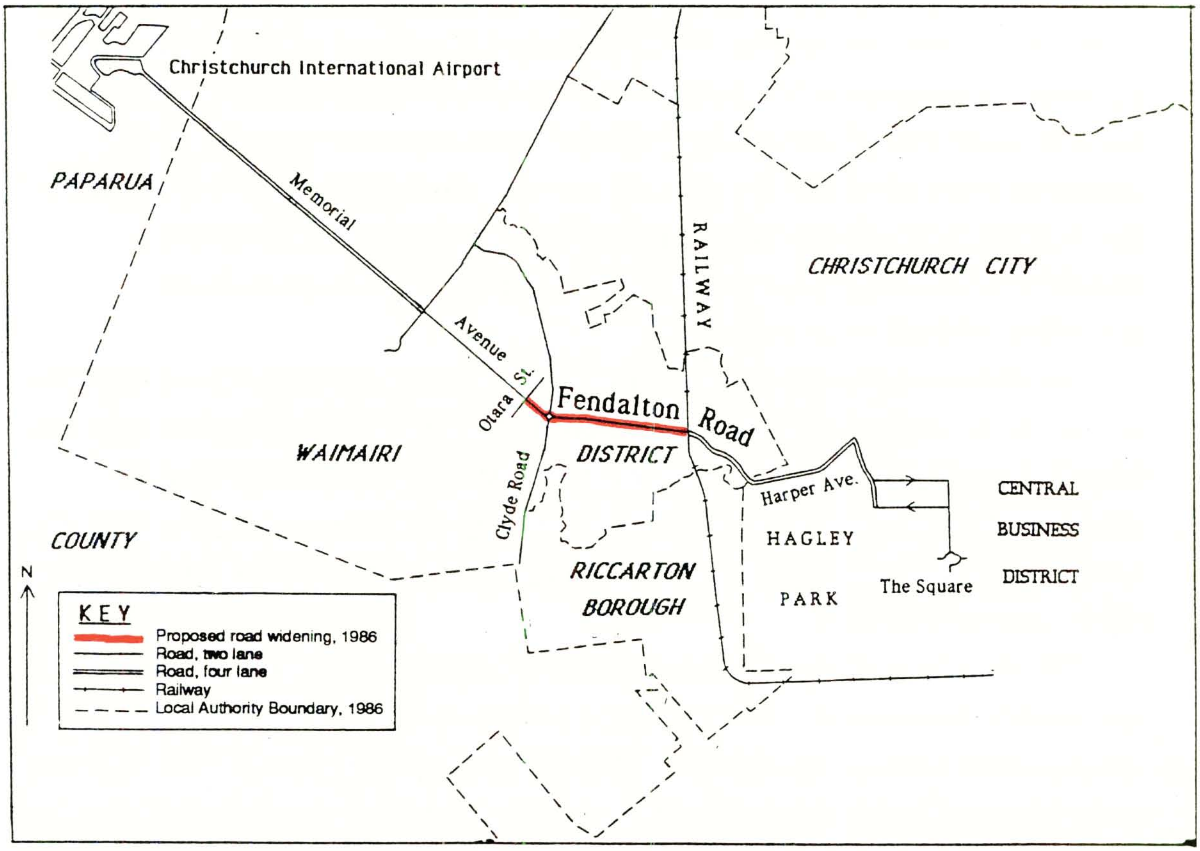


Figure 6.2. Location of Fendalton Road Widening Scheme (after Kirkpatrick, 1987).

Following a review of the District Scheme in 1983, which contains within it traffic plans among other things, the CUC asked the WDC to commission a report on possible options for the widening of Fendalton Road. Plans for such widening had been on the books for over twenty years, but had to be updated in order to attract funding from the National Roads Board. The report was prepared by WDC staff, in conjunction with private consulting firms, and presented in may 1986. It outlined six options for the future of Fendalton Road: a 'do-nothing' option, and five other options which involved varying degrees of change to the carriageway and its environs.

Maps accompanied each of the options (Figure 6.3). These maps were presented to residents who owned property likely to be affected by road-widening, but were not expressly drawn for that purpose. Instead, they were an attempt to meet a number of complex and often contradictory planning demands.

First, the maps were drawn to meet the requirements of the Town and Country Planning Act of 1953. In this Act and the documents proceeding from it regional schemes are supposed to both conserve resources and co-ordinate services, providing a high standard of service while preserving a desirable environment for living. However, the maps had also to attract funding from the National Roads Board, who were not constrained by environmental concerns to the same extent. Moreover, they had to meet the requirements of the WDC themselves, who had to balance local concerns and the regional traffic needs of an urban area beyond the boundary of their own authority.

In order to choose the 'best' option, a cost/benefit analysis was applied by the WDC traffic engineers to weigh developmental and environmental considerations. The result of this exercise saw option 4 selected and recommended to the councillors. Residents preferred no action at all, but overwhelmingly supported option 1 as the preferred option should any work have to be done.

During the research phase of the 1986 report three options were specifically focused on. Each of these options was given an 'in-house' nickname for ease of discussion. The option extending the greatest distance each side of the present carriageway, resulting in the greatest environmental impact, received the name *scorched earth*. This later became option 2. The option most closely resembling the situation as it was became known as the *natural* option, as it retained most of the natural features. This later became option 1. The compromise option, which preserved much of the 'green zone' of trees and lawns between the property boundaries and the kerb, was given the nickname *green*. This became option 4. Option 3 and 5 were added afterwards when councillors decided they would like a wider range from which to make a selection.

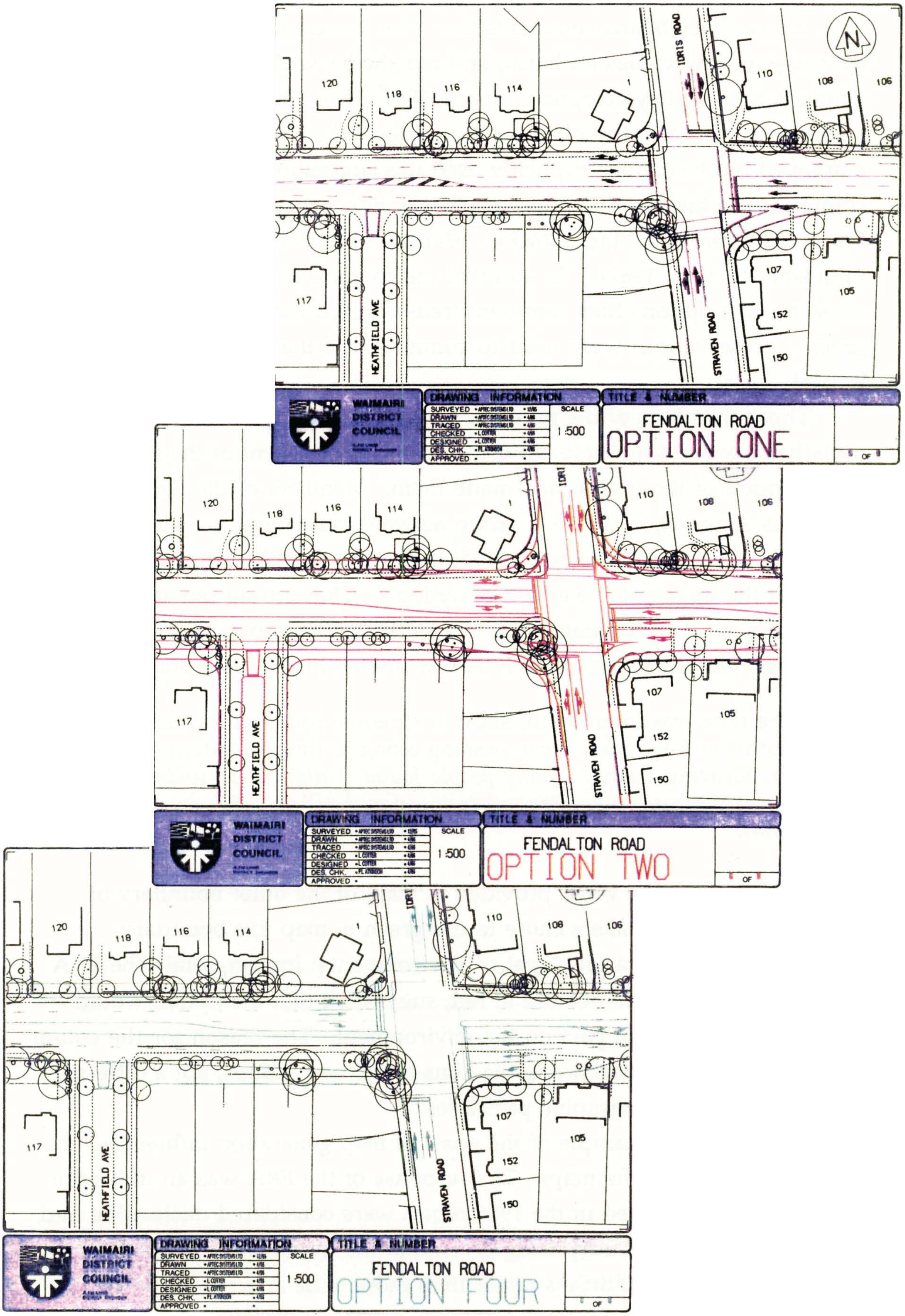


Figure 6.3. Maps of the Fendalton Road Widening options.

Christopher Board comments that "the association of green with decreases or low values [of harm] and red shades with increases or high values is now widely accepted" (Board, 1967: 690). The symbolism of red and green in what is a traffic plan is not coincidental. The draughtsmen employed by the council explicitly used this suggestion of value by colour to communicate the Council's opinion that option 4 was the best option (personal interview, Mark Gordon, Waimairi District Council Chief Traffic Engineer, 21 April 1987). He said that the colours, which emphasise the impact of the options they represent (red-scorched earth; brown - natural; green - preservation) were used to communicate the level of environmental impact.

Those members of the public who had occasion to use the maps reacted initially by expressing their confusion both at the content of the maps and at the intention of those who had made them. Members of the Fendalton Residents Association (FRA), a group actively campaigning against the widening scheme, decided to conduct their own graphic campaign to highlight the unacceptable effects of option 4. They strung red and orange tape across property frontages and trees to show the impact of the road widening. The chairman of the FRA was quoted in a news report as saying

> "The tape was intended to show the people living on or near Fendalton Road, and those passing along it, the real extent of the restructuring plans. *Many people found it difficult to understand a printed diagram*" (The Press, Wednesday April 8, 1987, emphasis mine).

Both the FRA and the WDC provided a 'map' of the outer boundary of option 4. The map makers chose to use green to map this boundary, indicating a belief in a low level of environmental impact, while the FRA chose to mark the same feature in red, suggesting that the option would have a high level of impact on the environment. The reason for the colour difference was the difference in the aims of the two groups, not a differing interpretation of cartographic principles.

This is a clear example of the goals of map generation influencing the form and content of the maps. The response of the FRA was an indication that the maps presented in the 1986 report were considered misleading and confusing. This is not surprising given that the initial targets of the maps were planners and politicians rather than those to be affected by the road widening.

The way in which the maps from the 1986 Fendalton Road Widening Report were generated, made and used is summarised as Figure 6.4. The map was produced for planners and politicians, who were the initially targeted map users. It was produced by a team of engineers from private companies and the WDC, the map makers. It was begun at the request of CUC and WDC officials (the map generators), to satisfy the requirements of the Master Transportation Plan and the District Scheme, documents representative of the social forces in which this project was embedded (Kirkpatrick, 1987).

However, it was not until the maps became available to a wider set of users, not targeted by the map generators or makers, that misunderstanding and conflict began. This is a clear example of the 'eavesdropping' effect, in which the residents used the maps *without being party to the original meanings of the messages they were receiving.* The example highlights an important point for discussion later in this chapter: why should there be a difference in response between targeted and non-targeted map users?

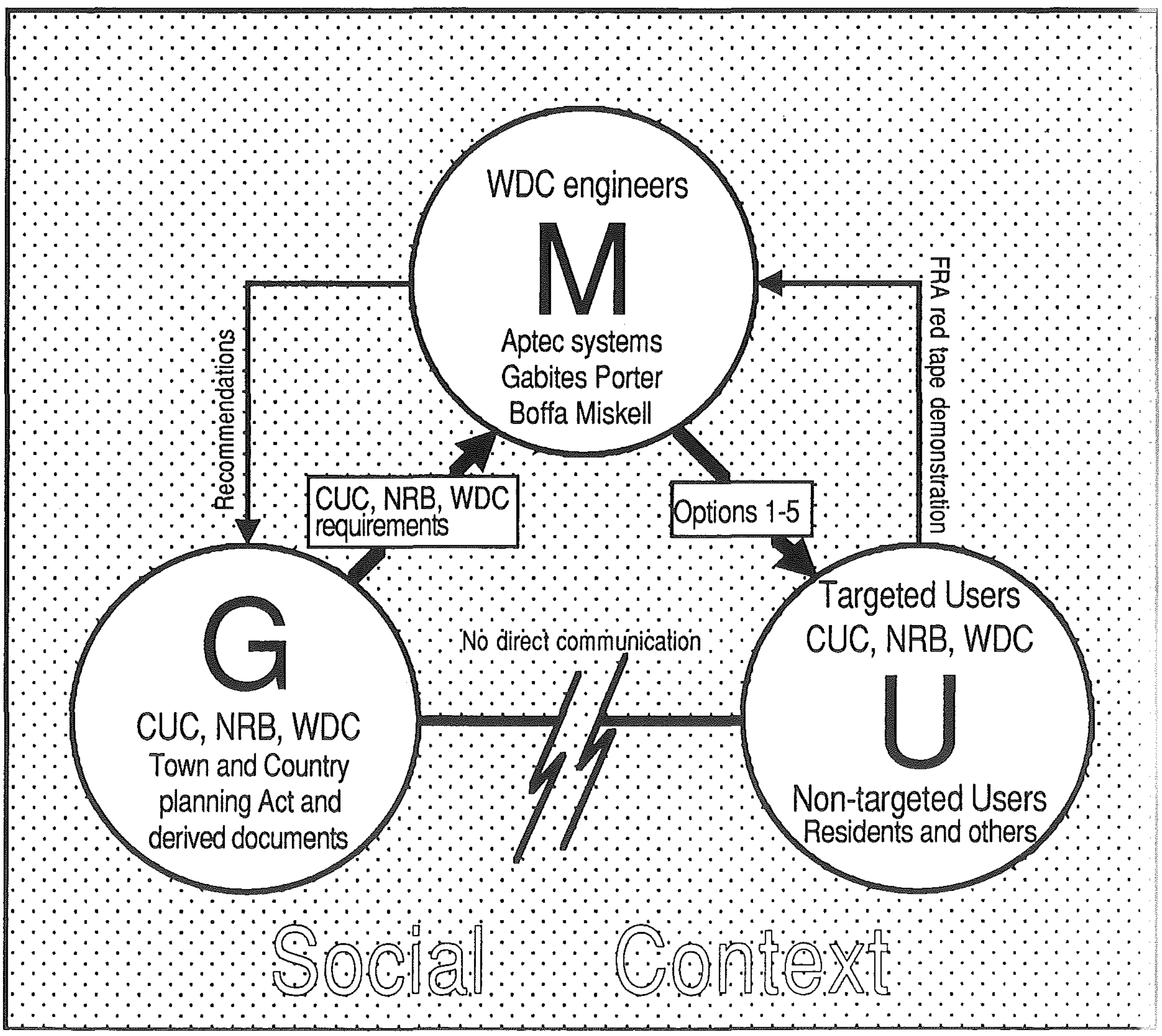


Figure 6.4. A MUG's analysis of the Fendalton Road widening scheme.

Non-metric Maps

Not all maps are produced by following exacting standards of map accuracy. Those that show spatial data without acknowledging the requirements of scale, projection, and other mathematical foundations of accurate maps are known as *non-metric maps.* These maps are produced for a wide variety of reasons, such as the illustration of research findings, to fill the place of unavailable or unsuitable topographic mapping, as commercial route-finding products (as in schematic road maps), or as an image designed to promote a product or idea.

Many of these map images have been designed to communicate *one* specific message. Unlike the type of maps hitherto discussed in this chapter, they do not present many items of weakly manifest information for the user to digest. Rather, they are produced specifically to enhance a message, complementing accompanying textual, pictorial or verbal information.

Often the map is reduced to an outline shorn of geographic detail. This is illustrated with reference to two maps used in television news broadcasts. The first, the present author's impression of which is shown in Figure 6.5, is a map generated by the CBS television network and used by Television New Zealand in November 1986. This map image of Libya was the background to a voice-over news item explaining that Libya sought United Nations censuring of the USA for that nation's air attack on Tripoli. The map used does not show where Libya is in relation to the United States or New Zealand, nor does it locate the U.S. Mediterranean fleet, the direction of the air attack or even Tripoli. Rather than using a location map, the network chose to use a map image to illustrate the thrust of the news message: the might of the USA (represented by the flag) overshadows a weaker nation. To enhance this message Libya was drawn in yellow, a colour often associated with weakness or cowardice.

The second television news map is shown in Figure 6.6. This montage of stylised outline maps of Iran, overlain with cutout silhouettes of major Iranian political figures, served as a background to a television news story about political dissension within Iran. The story claimed that antagonism with the United States was being used by these leaders to further their own interests within Iran. This suggested that Iran was a nation with divided leadership, a message supported by the multiple map images of Iran.

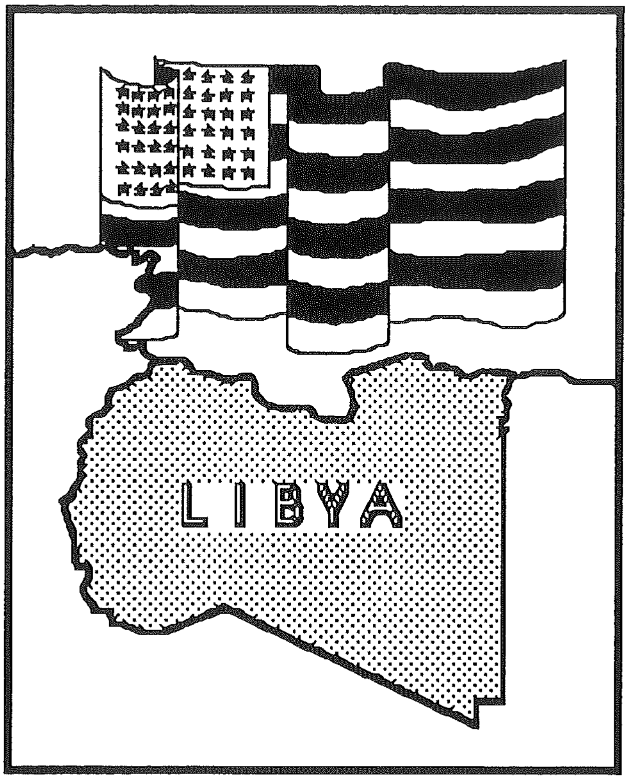


Figure 6.5. Television news map of Libya. Source: after CBS news report, November 1986.

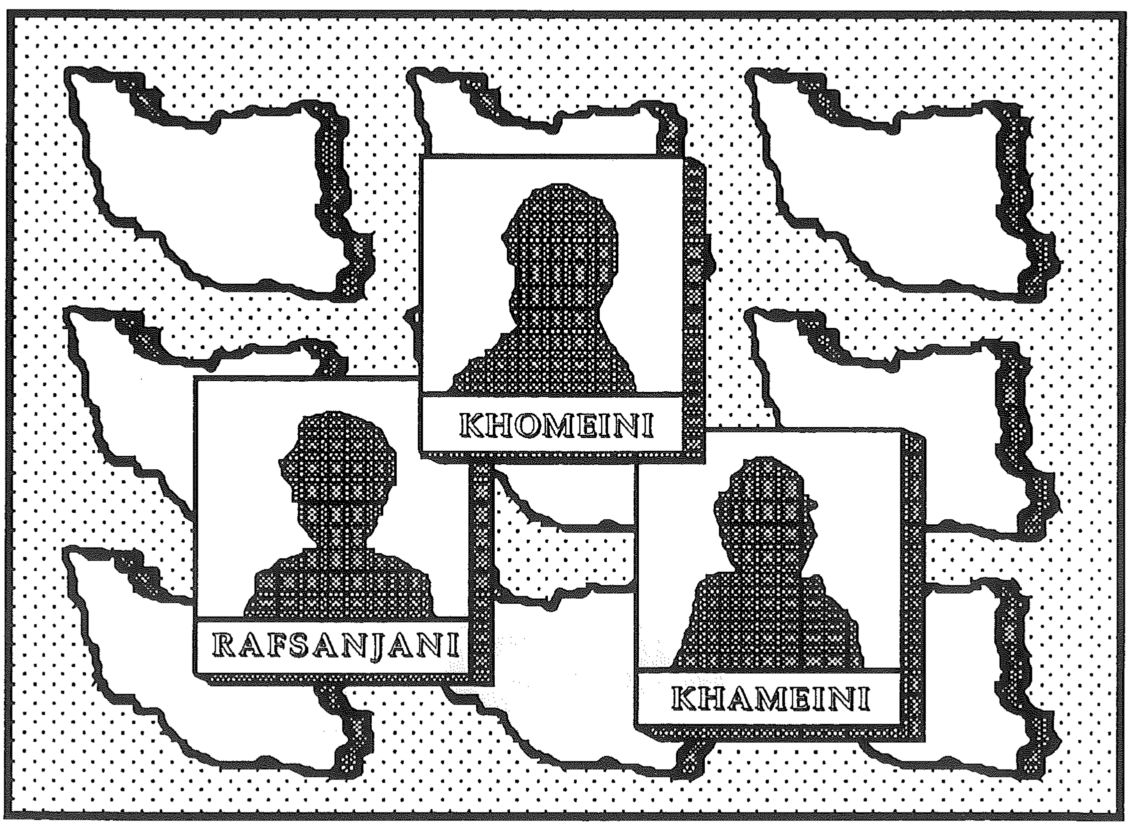


Figure 6.6. Television news map of Iran. Source: after CBS news report, November 1986.

Some map images can be more graphic art than cartography, relying for their impact on eye-catching surprise. Figure 6.7 gives some examples from advertising. These images are not referred to as maps by their creators, permitting them to ignore the requirements of cartographic convention while preserving their own integrity. As they are easily distinguished from 'genuine' cartography, the public are pleased rather than fooled by these efforts.

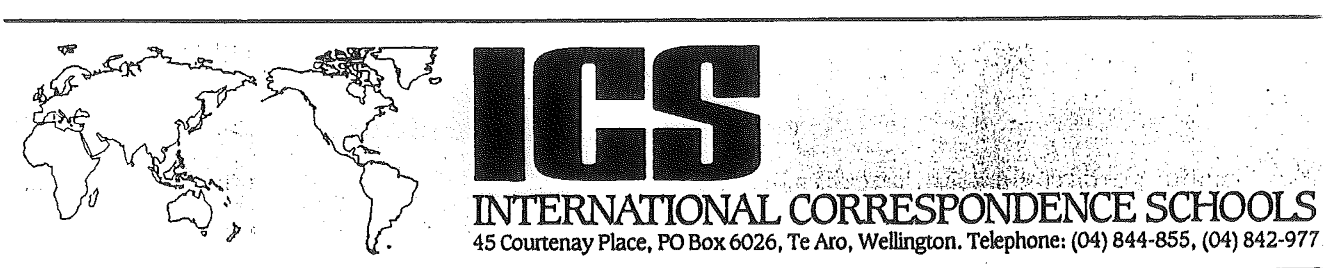


Figure 6.7. Map images from advertisements.

Sources: Holiday Shoppe, Bishopdale House of Travel, International Correspondence Schools.

Seemingly, the only people troubled by this sort of 'mapmaking' are some geographers. Balchin's "Media Map Watch" of 1984 monitored maps in the public domain with the objective of noting "deficiencies, errors, inaccuracies and misleading aspects as well as citing examples of exceptionally good presentations" (Balchin, 1985: 339). Objections to media maps included the absence of titles, projection data and graticules (grid lines), scales, orientation marks and legends, and the common practice of 'oversimplification'. Balchin notes that "the local press and advertisers collected the most adverse comments" and suspects that "only too often it is a graphic artist rather than a trained cartographer who is responsible for the maps that are published" (Balchin, 1985: 343).

The criticisms reported by Balchin are symptomatic of those who do not understand maps. To insist that only a map with a scale, graticule, title and a legend is a 'real' map is to deny much of the history of cartography. Graphic artists dispense with cartometric information not out of ignorance but because they believe it is irrelevant to the majority of the map's prospective viewers (personal interview, production manager of Gurney Nagle, 20 May 1987). Participants in "Media Map Watch" seem to be suggesting that all maps should be metric maps.

Other cartographic writers have tried to distinguish between the *propaganda* or persuasive map and the perfect or objective map (Ager, 1978). This attempted distinction is equally misguided. In suggesting that maps are either persuasive or objective depending on the honesty or otherwise of the map maker, Ager fails to recognise that even an honest cartographer who aims to produce an accurate, comprehensible and balanced map may find that he or she is honestly repeating the message of the map generator, legitimising that message by the addition of a spatial graphic. As has been mentioned, most cartographers are not free to select their material. Those who helped to produce The Philippine Atlas or the NZTP maps were, in all likelihood, beyond reproach. However, both of these works are, as has been discussed, exercises in persuasion.

Maps have been used to persuade because "map users tend to place inordinate faith in maps and accept them as true and complete representations" (Tyner, 1982: 140). Their air of scientific objectivity lends them, and any message they accompany, a greater degree of believability. Removing rather than reinforcing this belief will help map users to be more critical of maps: "no map should ever be considered apart from the broader aims of those who made it" (Murray, 1987: 241). Maps are powerful legitimising images and have been shown to have been used as such by the state, private groups and individuals in order to obtain better access to the distribution of power, prestige and wealth (Murray, 1987).

The use of maps is described in this section as being for control, development and persuasion. There is also a case to be made for maps being part of a simple provision of information, to which many examples such as road maps and weather maps may belong. It is important to note that in most cases the base information from which the map is constructed is still in state control. Because the profit motive inspires the provision of spatial information, even in a private sector as small as that of New Zealand's, this sector is almost totally dependent upon government policy for the provision of base mapping and so, indirectly, for its existence. In New Zealand most mapping endeavours are directly or indirectly influenced by state policy and control.

The Users and Non-Users of Modern Maps

Historical and contemporary examples have been presented to support the claim that the maps produced by modern society are impositional in nature. This section considers the impact of this type of mapping upon the citizens of this society.

The number of user surveys conducted by cartographers is small and the questions asked often ill-informed. "Incredible as it may seem, very little empirical research has been done on...the actual uses to which maps are put" (Petchenik, 1985: 11). The typical map use survey is characterised by the asking of questions designed to highlight strengths and weaknesses in contemporary mapping (or that subset of it under review), with a view to find out about maps, not users, in order to help the industry more effectively design and market maps - and make money. These surveys generally miss the mark. By concentrating on uses and sometimes users, they do not examine the uses to which maps are *not* put, nor do they survey the large number of people who, for one reason or another, do *not* use maps. Monmonier explains the importance of this concept:

> "Mapping has advanced to the state where the collection of many types of geographic information is technically possible and the principal constraints are institutional and political, not perceptual and cognitive. The map that is not made thus warrants as much attention as the map that is made" (Monmonier, 1982: 99).

In the same way, the person that does not use maps warrants as much attention as the person that does use them. This section suggests that many potential users of maps do not use them for a specific reason.

Following from this argument, three types of people will be examined with regard to their place in the cartographic communications system. Two of these categories of people are actual map users, while the third (potential map users) includes everybody else.

The Initially Targeted User

A.C. Marles, Deputy Director of Marketing for the Ordnance Survey in 1984, begins a discussion of map user needs with the following comment:

> "From its beginnings in the late eighteenth century, Ordnance Survey has existed to meet a user need. It was originally set up and funded by Government to make maps mainly for defence and fiscal purposes. Of course, there was no requirement then on the part of Ordnance Survey to identify user need - the customer set up the organisation to satisfy its own immediate needs which were quite clearly defined" (Marles, 1984: 135).

Marles identifies the generator as the government, and the 'customer', or initial user, of topographic maps as the military. Other government uses of maps, such as mapping for development or control, follow from this initial military requirement. The form and subject matter of these maps were explicitly tailored for these governmental uses:

> "The survey of a country is normally plotted as one or more series of maps at the largest scale which is convenient for the majority of administrative, economic or defence requirements" (Maling, 1989: 15).

This quote serves to emphasise the continuing role of the merchant, statesman and strategist in the development of a nation's official mapping programme.

The military has a profound influence on the subject matter of the topographic map. In the case of New Zealand medium-scale topographical mapping, the military is the only user invited to make submissions to, and with power of veto over, specifications for a new map series. When planning to introduce a new metric topographic map series, the Department of Lands and Survey (as it was known before 1987) had to ask military permission to make minor changes such as dropping the bridge descriptors (concrete, wooden, suspension etc.), the voltage of transmission lines and even the fenced/unfenced designation for carriageways. While conducting a field survey in connection with the preparation of specifications for the new metric 1: 50,000 topographic series (NZMS 260), Braugindle was provoked to comment:

> "There appears to be very little merit in showing on the map the construction material used for building the bridges observed, e.g. C - concrete, W - wooden. There is very little value in this information and the letters C, W take up space on the map unnecessarily" (Braugindle, 1972: 5).

Viewed from a historical military perspective, however, there was a great deal of value in this information. Transport of heavy equipment could be hindered by an insufficiently strong bridge, and the letter appellations helped in route determination. This is the reason that these descriptors featured on previous medium-scale topographic map series. However, with the improvement in bridge quality over recent years this was seen as less important and the military agreed to this change (Figure 6.8).

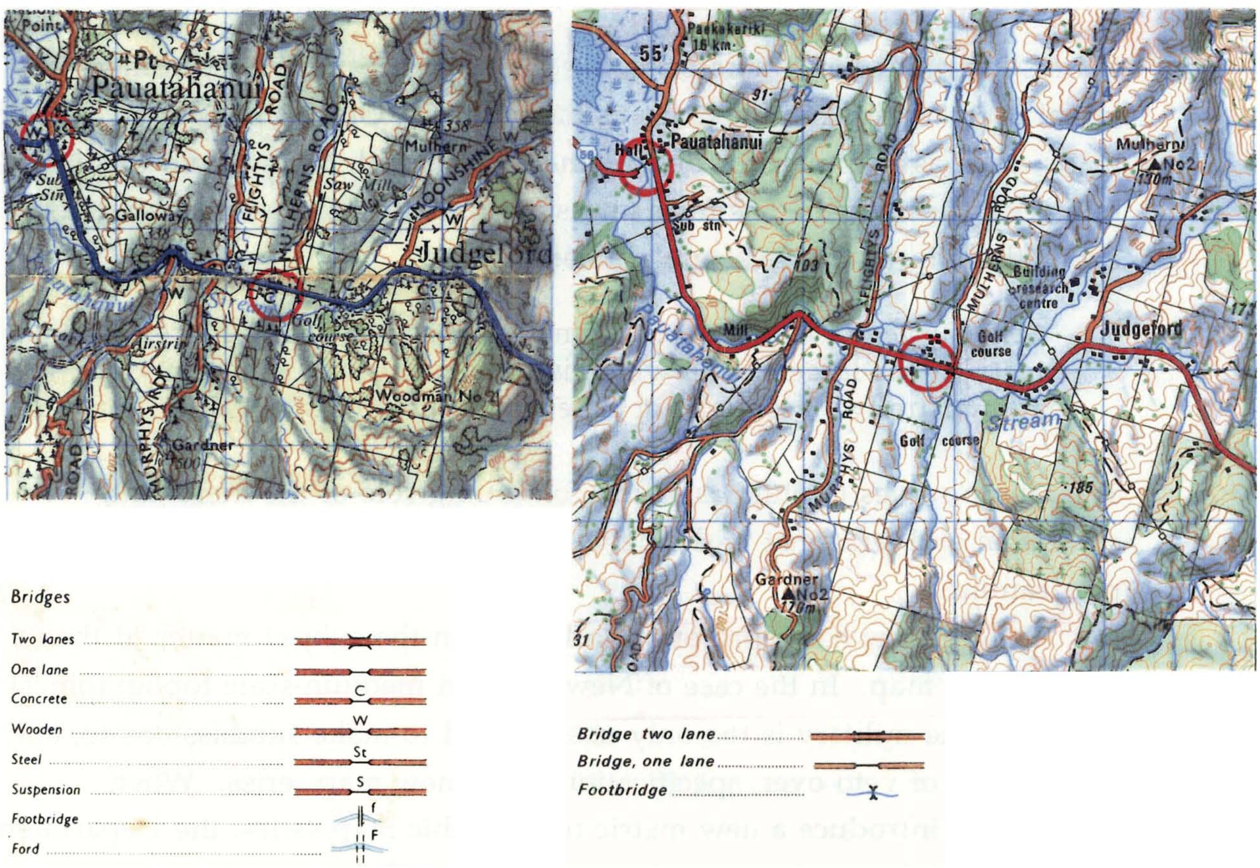


Figure 6.8. Military influences on bridge designation, NZMS 1, 1:63,360 and NZMS 260, 1:50,000.

Obviously, the initial targeted user is closely linked to the map generator. In fact, it may be difficult in practice to separate them. The military is able to exercise such an influence over topographical mapping partly because some of the funds for this mapping are channelled through the military by the state. This influence is augmented by DOSLI structure, where the surveyor-general holds the honorary rank of colonel in the army, and historically a number of the administrators and cartographers in the Department had served or were serving with the forces.

There is historical justification for the pre-eminence of the military in determining topographic map specifications. Figure 6.9 shows that soon after World War Two over half of the topographic maps produced were 'service issues', while another large proportion went to other government departments (such as universities, scientific research etc.). As late as 1967 the armed services received over 85,000 topographic maps, representing 44% of the topographic maps distributed. Since 1960, however, over 50% of topographic maps have consistently been purchased by the public. The initially targeted user of these maps is now no longer the largest user group.

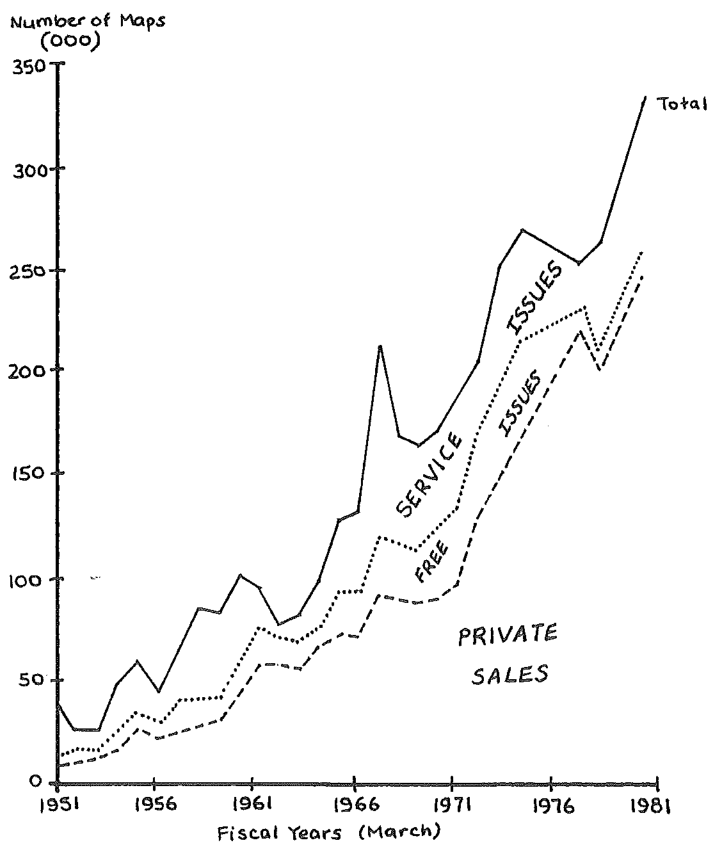


Figure 6.9. Demand for topographic maps in New Zealand 1951-1981.
Source: after Hoogsteden, 1988: 250.

Secondary Users, 'The Serious Map User'

Latterly it has been realised that other users could take advantage of the type of information required for military purposes. Marles comments:

> "... as map coverage increased and maps became more widely known, so also did their potential uses increase as a variety of different users came to realise the benefits of accurate and reliable maps" (Marles, 1984: 135).

This was an incidental discovery, a fortunate event not planned for in the original conception of topographical mapping but one increasingly exploited by map marketers seeking a financial return on the vast sums outlaid on survey and mapping.

These 'second tier' map users are called 'serious map users' by DOSLI (Hoogsteden, 1988) and have been identified as economic users (such as engineers) and recreational/social users (trampers, hunters and fishermen). This name has been given to them because they are well above average in their level of cartographic education: only two per cent of serious map users included in Hoogsteden's Ph.D. survey of New Zealand economic and social map users admitted to having no cartographic training.

Table 6.1 outlines the origin of cartographic training received by these serious map users. Significantly, 56% of economic users gained their cartographic training from tertiary institutions, while only 2% of social users were trained at universities or technical institutes. 65% of Social users, on the other hand, learned how to use maps through sporting or social contact, a more informal method through which only 9% of economic users were trained.

User Group	Origin of Cartographic Training % distribution						
	None	School	Polytech	University	Military	Sport/Social	On Job
Economic	3	12	8	48	5	9	15
Social	0	2	0	2	6	65	25

Table 6.1. The Education of the Serious Map User. Source: Hoogsteden, 1988: Appendix A.

This indicates a substantial difference in the two populations, economic users having been formally trained in the general rules of how one ought to use maps, while the social users have been trained in the specifics of map interpretation as it relates to their use activity. Overall, 90% of social users received this sort of informal training (whether at work or recreation) while only 24% of economic users were trained informally. The formal education is generally heavily reliant on cartometric principles. From these figures it could be suggested that, according to DOSLI's definition of this group, economic users are more 'serious' than are social users.

The fact that these secondary users are able to make use of map accuracy may confirm the belief of official map generators in the suitability of these maps for public distribution. Curiously, the disparity in cartographic educational standards between secondary users and the rest of the general public may offer further confirmation. The present author has been part of a number of informal discussions in which it was suggested that the inability of individuals to interpret topographic maps was entirely the fault of the individual's lack of training, and not a problem with the form or subject matter of the maps in question (discussions with NZTP and New Zealand Cartographic Society, 1987).

Without redesigning the topographic map and thereby abandoning the original targeted user, map marketers seek to enlarge the number of people using these maps in order to better meet the demands of cost recovery. As a consequence, Hoogsteden could write in 1988 that while the needs of users other than the military have been given little or no consideration, in the last three decades this has begun to change slowly. Marles speaks of "the development of a commercial marketing policy which positively seeks to identify and then meet user need" (Marles, 1984: 135). There are two forms of identifying this user need - consultative committees and market research.

To test the assumption that "what [we] have traditionally provided is what the user wants" (Marles, 1984: 136), Ordnance Survey consultative committees in the United Kingdom met with public sector groups and private organisations such as motor rallyists, horse societies and the like. Keates says that "there has been a perceptible increase in the attention given to map user groups" (Keates, 1989: 149). The serious map user is consulted if he or she is part of an organised group, but there is seemingly little room for individual input other than the writing of letters to the mapping agency: Marles notes that, regarding the Ordnance Survey,

> "The users themselves are quite forthcoming on the subject of their needs and preferences, demonstrated by the 30,000 or so letters and telephone enquiries answered each year from members of the public" (Marles, 1984: 137).

Marles does not report on the nature of these enquiries. It would be sensible to assume that many of these were questions related to availability and price. Even taking this into account, there are, apparently, a large group of users who are 'serious' enough about their concerns to take the trouble to make unsolicited contact with Ordnance Survey.

This suggests that market research might be an effective way of widening the target audience. While some researchers, either sponsored by mapping organisations or working from within academia, have conducted surveys (Kirby, 1970; Drewitt, 1975; McGrath, 1986; Hoogsteden, 1988), many mapping agencies do not conduct user research at all: "The best form of market research is trial and error" (Smith, asst. Surveyor-General, Department of Geographic Information (Sunmap), Queensland; *pers. comm.* 1988).

The results of market research merely confirm the agencies' perception that they cater to a select group of 'second tier, serious map users':

> "While OS were pleased to find that they were highly regarded by the public as an organisation noted for professionalism and high quality work, it seemed that the purchasing public comprised an enthusiastic elite not exceeding 25% of the adult population" (Marles, 1984: 137).

It might be that the very professionalism and high quality of the work produced is the factor that prevents a higher degree of access from potential map users.

The Potential Map User

To extend the target audience for topographic maps (and other official mapping), any further than the two tiers of users already identified must mean discovering, considering and meeting the needs of those presently not using these maps. Marles offers this most important comment on the non-use of Ordnance Survey (OS) maps:

> "What was more revealing was the huge potential market revealed by the market research which was 'frightened off' using OS maps by just that complexity and accuracy that appealed to the map buffs. In direct contrast to the 25% of regular map users, the other 75% appeared to have needs which centred around simpler products which were both functional and interesting" (Marles, 1984: 137).

Marles' argument is central to this thesis. It is argued that *map complexity and accuracy serves the interests of initial and secondary map users at the expense of making maps intellectually inaccessible for the majority of potential map users.*

Interestingly, even the 'serious' map users of New Zealand's official maps do not require the level of positional map accuracy they are provided with. The needs of users have been comprehensively assessed by Charles Hoogsteden (1988). In his questionnaire, administered to economic (work-related) and social/recreational users, he asked the question: "If you are not satisfied with government map products [for work] please give your reasons" (Hoogsteden, 1988, Appendix B). A closer look at the category 'accuracy' (Table 6.2) shows that no social users, and few economic users, find NZMS 1 topographical maps inaccurate with regard to position or consistency (a synonym for completeness). In the eyes of these users map inaccuracy is almost entirely due to errors in map content, and this inaccuracy is even more important to social users than to economic users.

User Group	**Reason for Dissatisfaction**		
	Position (positional) %	Content (qualitative) %	Consistency (completeness) %
Economic	2.4	13	0.4
Social	0	31.1	0

Table 6.2. Percentage of Users of NZMS 1 1:63,360 topographical maps who are dissatisfied with map accuracy. Source: Hoogsteden, 1988: Appendix A.

In assessing these results, Hoogsteden commented:

"Re-examination of the original data revealed that these Social users, who are mostly outdoor recreationalists using the medium-scale topographical series, identified errors or omissions in content as a matter of concern. Examples included information on maps which showed huts which are no longer there, or that new huts were not shown, and that trails appear which are no longer in existence" (Hoogsteden, 1988: 332).

The DOSLI horizontal positional accuracy requirement for 1: 63,360 maps of ± 5 yards or 4 metres is required by only 1% of economic and 2% of social users, while the vertical positional accuracy requirement of ± 5 feet (1.5 metres) is required by less than 10% of economic and 3% of social users.

The positional accuracy requirements considered acceptable by DOSLI are much more exacting than those expected by their users.

It can only be speculated that non-users have even less requirement for the degree of accuracy advocated by map generators. By being 'frightened off', potential map users are effectively disenfranchised from a large pool of potentially useful knowledge, and by not having their needs for simpler, functional and interesting maps met, are confirmed in their non-user status. The present condition of cartography is essentially one of exclusion of the larger proportion of the population.

In the case of the Fendalton Road Widening Scheme, the maps failed to convince local residents that the option chosen by the WDC was the best one. In fact, residents reported confusion as to the message of the maps. Again, this is because the maps were not targeted at the residents. Map misinterpretation was a problem of generation, not of user incompetency.

The provision of alternative map products is a crucial question which cannot be left to the non-user to address. People do not knowingly look for radical new solutions to the problems of spatial representation. In fact, "the map user has historically been conditioned to accept the product offered, e.g. in military parlance 'we know what is good for you'" (Staal, 1986: 113). Yet, as Petchenik (1985: 14) identifies, "for any one use by any one user, no map ever seems to be quite right". We want to go south, but the map is oriented to the north and is hard to read. We're looking for a room for the night, and have to infer the presence or absence of accommodation from the size and position of the town. We plan an itinerary but the map does not highlight the towns we want to go to. The problem is simply stated, yet solutions appear complex. People require user-determined rather than generator-determined map specifications.

The cartographic configurations upon which society depends are unlikely to be discarded in favour of some new, more relevant formulation. Keates reminds us that "the basic specification of map content and design cannot be easily changed" (Keates, 1989: 193). Because "carrying out a full topographic survey, simply to publish a few sheets of interest to a small number of potential users, is difficult to finance unless subsidised in some way" (Keates, 1989: 193), the wishes of map users and non-users, when heard and acknowledged to be of significance, will continue to be incorporated only on maps based on existing forms of topographic data. Petchenik acknowledges that because of financial constraint, companies such as the one she works for "usually try to please many clients with a single map" (Petchenik, 1985: 17).

The major obstacle to the provision of maps to satisfy something like 75% of the adult population appears to be financial. Indeed, it is argued that the level of generator control in mapping products is a function of cost. Figure 6.10 ranks maps according to the degree of cost, control and 'end user' input into their specifications. The simple relationship is discerned that the higher the cost, the higher the level of state control and the lower the level of end user input.

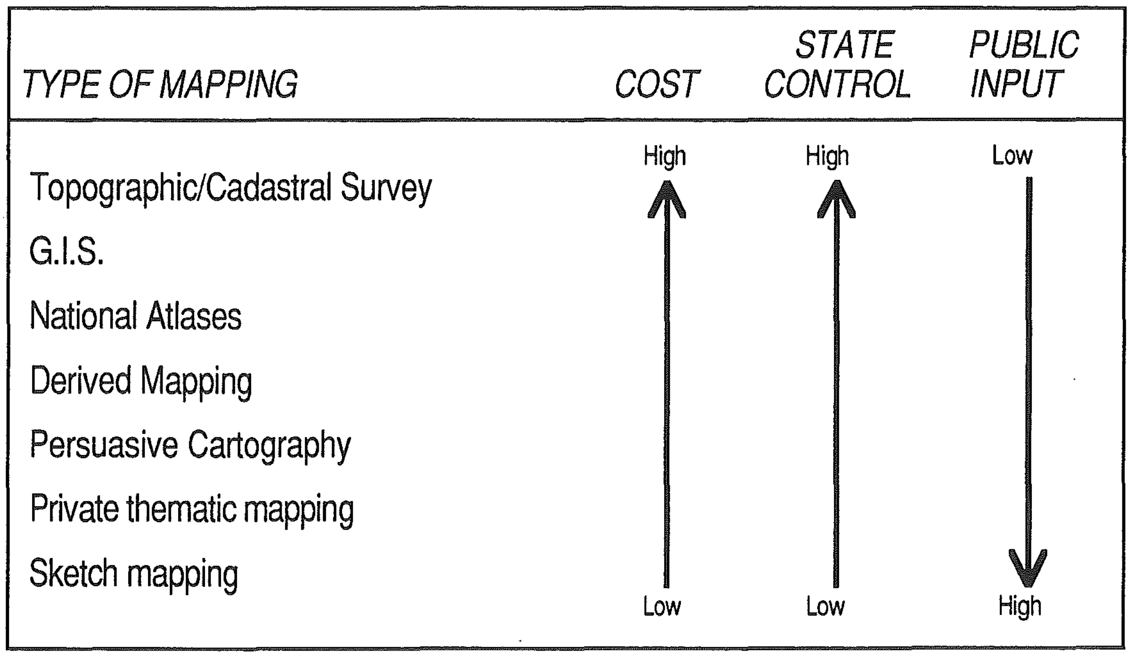


Figure 6.10. The hierarchy of cost and control in modern mapping.

Three main points arise out of this discussion of map users and non-users. First, the original products are often provided to a narrow range of users, if not one single user. Secondly, it is a fortunate accident that other uses have been identified for many of these products. Thirdly, significant changes to basic mapping are apparently necessary to make maps relevant to potential users, but are contingent upon the identification and capture of relevant data, which invariably is expensive and must be funded. Chapters Eight and Nine of this thesis are an exploration into the theory and practise of the computer generation of a community database, an exercise in alternative provision of relevant spatial information.

The following conclusion summarises the arguments presented in this chapter. It precedes a section reviewing the deficiencies in cartographic communication discussed in the thesis to this point, concluding Part Three of the thesis and answering the first two thesis goals.

Conclusion

What is mapped in contemporary society, how it is mapped and who has access to the map is governed primarily by the wishes of the map generator who works in a specific social context. Because the society under review consistently rewards developmental, military and political goals over other factors, map generators fund the deconstitution and reconstitution of only that data which will help achieve those goals. The increasingly high costs of gathering data for the construction of accurate maps has concentrated the power to do so in the hands of those who can afford such costs: "...the means of cartographic production, whether commercial or official, is still largely controlled by dominant groups" (Harley, 1988: 302). Cartography has evolved in response to this, so that the types of survey and mapping techniques employed are best suited to the capture and portrayal of that data dealing with the agenda of map generators. The status quo is thereby perpetuated.

With so much of the profits of development depending upon precision and accuracy, the science of cartometry has come to dominate the thinking of professional mapmakers and teachers of cartographic principles. The map now has a clearly drawn border, both literally and metaphorically, preventing the user from being distracted from the task at hand (Kingsbury, 1969). The degree of map accuracy and complexity this has created is desirable to a minority of potential map users. It may have prevented many people from becoming map users, intimidating them into leaving 'official' maps alone. While it has been successful in augmenting the developmentalist aspects of western society, the basic formula of conducting surveys for military purposes and deriving all other maps from these surveys is failing the majority of people. Much of contemporary cartography is irrelevant and virtually unusable to many people because the underlying message, and the way that message is expressed, fails to capture their imagination and so, according to the principle of Relevance (Chapter Four), is not worth their attention.

Accurate maps facilitate the development of natural and social resources, assist in state control, increase national prestige and create a believable image to augment any persuasive message map generators seek to convey. Maps could, but do not, represent the spaces of imagination. Spaces of familiarity or transcendence, fear or ritual, utopia or desire, public spectacle or private seclusion are all spaces important to people, spaces with the potential to be represented. Any alternative cartographic formulation will have to be capable of representing such spaces.

A Review of Mapping Deficiencies

A number of potential difficulties with map interpretation have been introduced in the first six chapters of this thesis. These can be summarised under three broad statements, as follows.

Statement 1. *The planimetric, scaled view of the world alienates many people.*

The requirement by map generators and initially targeted users for a high degree of accuracy in maps has led to the development of cartographic techniques and forms of representation that 'frighten off' many people (Marles, 1984). In order to show as many topographical features as possible without obscuring them, map makers developed the vertical (planimetric) view, where the individual views from above and outside the depicted space, thereby abstracting that individual from that space and requiring a 90 degree rotation in the viewer's mind. These maps are static and flat (Hägerstrand, 1983), unable to portray the multidimensional character of everyday life (Gould, 1981). They make use of the orthogonal both for their axis of view and the organisation of information within their borders, a use which has been formulated to be impositional in nature (Edgerton, 1986). It does not allow for the placing of the user's self on the map.

Humans operate in a cognitive space not reflected by conventional mapping (Muehrcke, 1974). Many geographers have experimented with the parameters of cognitive space in order to better present human values (Tobler, 1961; Forer, 1978), but these have tended to be those most amenable to empirical analysis. Moreover, none has succeeded in becoming widely available to potential map users. Conventional map projections may not contain the best spatial parameters to portray human spatial behaviour and, if they are used in decision-making, may result in inhumane planning decisions (Muehrcke, 1974).

Influenced by the mathematical foundation of the planimetric perspective, cartographers favour the use of arbitrary map symbols which have mathematical rather than pictorial relationships with the objects they represent. However, the transformation from referent object to arbitrary map symbol may divest that object of its essence. Once a physical object or living thing is represented in symbolic form on a map, particularly if that symbol is an arbitrary rather than a mimetic (pictorial) representation, it is easy to forget the character of the original object or thing (Muehrcke, 1974). By representing the form of an object rather than its substance, map makers may be encouraging map users to disregard the meanings of map symbols.

Statement 2. *Subject selection based on the wishes of map generators results in distorted images of the world, focusing on physical spatial attributes to the detriment of human geography.*

Maps have been used to impose upon people and the environment (Harvey, 1984; Harley, 1989). This imposition is not driven by cartographers, who typically do not initiate the mapping process (Keates, 1982). Behind most cartographers there is a patron (Harley, 1989), an individual, group or institution identified in this thesis as a map generator. Map generators choose to sponsor the mapping of only those subjects that advantage them by providing a return, be it of finance, status or power. Such communication imposes upon the negative face of its audience (Austin, 1987), thus engendering unequal relations. Often, such an audience has little power to modify the map or to enter into dialogue about it, signifying a lack of iteration in the communicative procedure (Petchenik, 1985). The real communication is between the map generator and the initially targeted user, with other users relegated to the position of eavesdroppers in a conversation not originally intended for them, which enhances the possibility of misunderstanding.

The subjects that have been chosen by the leaders of contemporary society as worthy of being mapped are those that can be mapped accurately, and so are empirical in nature: visible, tangible, static, physical and historical (Muehrcke, 1974). The emphasis on accuracy may lead to an over-dependence on quantitative data in decision-making (Monmonier, 1985). The tendency is for the more intangible values to be ignored. This lack of human spatial attributes on maps, such as feelings, opinions and emotions, contributes significantly to the barriers to spatial information (Keates, 1982) because the desired product is either non-existent or is a personal or academic thematic map not accessible to the general public.

Because map generators decide what is to be mapped, and because the techniques of map makers have been developed to meet these limited needs, the maps produced in contemporary western society represent only a small fraction of that which is possible to be mapped. The important issues portrayed in maps are the visible, the tangible, the static, the physical and the historical. The slanted selection of information that is presented cartographically reinforces a particular positivist, empirical image of the world in the minds of map users.

Statement 3. *The search for a general theory of cartographic communication has seriously sidetracked cartographic research.*

Positivist research has focused on the measurement of the effectiveness of communication channels rather than the transfer of meaning (Board, 1967). The issue of concern to theorists has been the *competence* rather than the *relevance* of the map message, an emphasis that has led cartographic research into a cul-de-sac (Keates, 1982). Neither the process nor the semiotic model of communication shows how a speaker and an audience with mutually manifest contexts and inferences can communicate effectively.

People are shown to infer from maps rather than decode them, using a system of suitably constrained guesswork (Sperber and Wilson, 1986). Because maps are normally intentionally deficient in ostensive stimuli, attempting to make many factors weakly manifest, the user is in danger of missing relevant information. It is towards a study of these factors that cartographic theorists could most usefully turn in their attempts to provide better reconstitutions of spatial data.

The first two thesis goals have now been addressed and answered. The next three chapters build upon the concepts introduced thus far to present alternative cartographic formulations, seeking to address many of the unnecessary deficiencies in the present system. Chapter Seven deals specifically with statement 1, examining alternatives to planimetric space. Chapter Eight is concerned with aspects of statement 2, demonstrating how subject selection might better be conducted by the users of maps than by their generators. Statement 3 is pursued in Chapter Nine. The discussion provides an example of a mapping system constructed using the guidelines of Relevance theory and the MUGs model, attempting to provide map users with cartography relevant to everyday issues.

Chapter Seven

Alternatives for Reconstitution

Introduction

The fourth and last part of this thesis is concerned with exploring alternative cartographic formulations that might ease some of the difficulties users may experience with map interpretation. The discussion in this chapter examines possibilities for overcoming deficiencies in the reconstitution of spatial data. This is the issue which was the concern of the first of the three statements listed in the conclusion to the previous chapter.

Three examples of alternative reconstitution are presented. Each of these examples was constructed by the present author to deal with a real-life situation rather than being merely theoretical. The next chapter (Chapter Eight) pursues statements 2 and 3, assessing ways of allowing users to take part in the deconstitution process by participating in subject selection and data gathering. Chapter Nine is an empirical test of some of the ideas assessed in Chapters Seven and Eight.

The Need for Alternatives

Drawing the conclusion that mapping as a means of spatial communication is deficient in certain areas does not automatically imply that alternatives should be sought. No language is perfect, and all communication is fraught with the possibility of misunderstanding and its consequences. A range of responses to deficiencies in spatial data reconstitution could be appropriate, from a laissez-faire approach through improvement and reform to outright rejection of contemporary mapping, accompanied by a total reformulation or a nihilistic denial of all possibility of communication.

The stance taken by this author is that a reformation is required of some mapping types at large scales coupled with a more cautious improvement of existing map types at smaller scales. This reformation will be combined in the next chapter with a more radical reformulation of the subject matter with which maps deal. Such a reformulation is justified by the discoveries already made in this thesis, as summarised by the three statements at the end of the previous chapter.

Fundamental to this thesis has been the division of the concept of the map into two parts: form and content. As introduced in Chapter Three, map content is the collection and manipulation of data considered relevant to the subject of the map as determined by the map generator. The activity of assembling the content of the map was called *deconstitution*. Map form is the way in which the map content is displayed, with the activity of constructing the map from its data base being referred to as *reconstitution*. This division is revealed to be crucial because the deficiencies identified in each activity are quite different in nature, as will be the solutions.

A simple diagram is now presented to summarise the alternatives for reconstitution and deconstitution in their broadest form (Figure 7.1). The diagram is explained as follows. Maps can have either traditional or innovative content. 'Traditional map content' is content favoured by map generators in historical and contemporary western society, that which the previous chapters argue is impositional in nature. 'Innovative content' concerns aspects of the human condition and the environment not normally part of traditional content. Similarly, maps can take a traditional or innovative form, the definitions of traditional and innovative map form paralleling those of map content. If a map has 'traditional' content, it can be presented in either a traditional (Tc/Tf) or an innovative (Tc/If) manner. If it has innovative content, similar options exist (Ic/Tf, Ic/If). Thus there are four possible combinations. The simple argument of this chapter is that the map maker should be free to choose the form most appropriate to the reconstitution of the particular content of the map, bearing in mind the nature of the likely audience and the need to overcome as many of the deficiencies identified by statements 1, 2 and 3 as possible. The next chapter focuses on the argument that spatial data should be deconstituted, if not by map users, then with regard to the express wishes and needs of potential map users.

The *scale* of a given map influences the degree to which innovation in map form and content is possible. There is a greater degree of freedom for individual expression if the map addresses a particular problem at a large map scale than there is if the the scale is smaller. The issue of scale is highlighted later in the chapter when two types of spatial learning procedures are uncovered, the differences between them being dependent primarily on the scale at which they are conducted.

		Content	
		Traditional	Innovative
Form	Traditional	Tc/Tf	Ic/Tf
	Innovative	Tc/If	Ic/If

Figure 7.1. Alternatives for Reconstitution and Deconstitution.

A further obstacle to be overcome in the provision of alternative cartography is people's *preconception* of what is and is not a map. The introductory chapter to this thesis recorded that, while the definition of what constitutes a map is wide, the standard topographical map was selected by more people than any other image (page 9). It is, apparently, more 'map-like' than the others.

That preconceptions influence the perception of what constitutes an acceptable map is easily demonstrated. During a 1987 meeting of the New Zealand Cartographic Society, members were presented with and asked to interpret a non-metric map of the South Island. Although many of these people were trained cartographers, few thought carefully about the map. Instead, it was dismissed as a 'fun map'. Having been trained to value traditional planimetric cartography, they were critical of an image which showed outsized skiers rushing down precipitous slopes, trains stretching tens of kilometers and sketches obscuring topographic detail. This, they felt, cheapened their profession.

Any alternative cartographic reconstitution must be based upon a carefully articulated view of space. Since maps represent spatial data, the way in which those data are organised is fundamental to the form maps take. The discussion continues with a review of the different types of spaces that make up our world. Ideas developed in later sections of this chapter are based in this general discussion.

Alternative Spaces

Euclidean Space

Euclidean geometry, considered by the writers of The Concise Oxford Dictionary (1976) as being that of ordinary experience, is a set of working laws based on those used by Euclid, an Alexandrian geometrician of the third century B.C. These 'laws' have come to represent, in the minds of many people, the most logical or indeed the only way of ordering space, having an existence independent of the minds that conceive of it. It is seen as an absolute space, giving us the 'real' picture. However, it should be noted that, like all conceptions of space, Euclidean space is a social construct (Sack, 1980). There are still some cultures, in spite of the ubiquitous influence of western thinking, that structure their space quite differently. The error, as Yi-fu Tuan explains, is to

> "assume that geometrical space is the objective reality, and that personal and cultural spaces are distortions. In fact we know only that geometrical space is cultural space, a sophisticated human construct the adoption of which has enabled us to control nature to a degree hitherto impossible" (Tuan, 1974).

He states that the Euclidean conception of space has served the interests of those seeking to gain control. This argument was raised in Chapter Six, where it was asserted that the gathering of precise information about something is an important first step in controlling that thing. Tuan argues that this way of thinking about space requires one to view space as separate from oneself and containing that which is 'other'. He suggests that this view of space has sprung from western dualism with nature, and was a necessary prerequisite to organising the complex society that followed industrialisation (Tuan, 1974).

Yet there appear to be good reasons for using a standardised spatial metric. Robert Sack reasons that geographers using cartography have employed Euclidean space as a universal cartographic language, ameliorating some of the problems caused by differences in spatial perception and description. Any given person literally sees things slightly differently than does his or her fellow, due to factors such as age, personality, location and experience, these being exacerbated by cultural differences.

> "The map can coordinate personal views and perspectives with a standard yet flexible description of space... the map allows geography to perform its most basic function of standardising perspectives of space and providing objective descriptions of the spatial properties of things" (Sack, 1980: 5-6).

The fundamental problem with this reasoning is that it is contradictory. Sack argues for both a standard and a flexible reconstitution, two requirements which cannot both be fulfilled in the same map. In practise cartography has become rigidly standardised at the expense of flexibility, with objective spatial descriptions of things subsuming personal views and perspectives.

The development of modern western cartography parallels that of Euclidean space, with the objective of both being the imposition of the human will upon nature and people by the use of geometrical forms. There are cartographers, however, who have questioned the habit of using Euclidean geometry in modern cartography. Muehrcke suggests that

> "Although the assumption of a Euclidean basis for spatial patterns suffices in the study of many physical phenomena, there is little theoretical basis for this choice of geometry in the study of social/spatial cultural relations" (Muehrcke, 1972: 43).

In agreeing with Muehrcke, it should be recognised that Euclidean space, unlike orthogonals, is not intrinsically impositional in nature. Though Euclidean space is defined in a rigorous and inflexible manner, there is more than one way of organising space even according to Euclidean principles. The key is to resist formulating a universal 'law' or principle, instead using whatever reconstitution is most appropriate. A balance must be struck between spatial anarchy, where each person makes his or her own space and communication is impossible, and one inviolate usage (Forer, 1978). The present author seeks an alternative cartographic reconstitution that will better reflect the ways people perceive each other and their environments. Cartography could be an ideal tool for people to express their own views on how human-environment relationships that concern them might be reformulated. To this end spatial conceptions that are derivatives of Euclidean space will be examined, as will non-Euclidean spaces.

Planimetric Space

Planimetric space is a subset of Euclidean space. It is a way of thinking about space particularly suitable for the metrically accurate portrayal of the relationship between physical features. Metric maps are a representation of planimetric space, that is, mathematical spatial relationships are preserved from a vertical perspective. Metric maps are a deformation of three-dimensional planimetric space in order to conform to a two-dimensional surface. This is done by 'projecting' three-dimensional attributes on to a flat surface.

It is at this point that some of those who teach cartographic methods distinguish a true map from other spatial representations. Drawing the boundaries of his definition of a map very tightly, John Keates (1989) distinguishes maps from other two-dimensional graphics in two ways: *perspective* and *symbology*. He argues that the perspective of a true map must be "an orthogonal projection of the Earth's three-dimensional surface on to a plane" (Keates, 1989: 3), as shown in Figure 7.2. It must be emphasised that, by this definition, the map is not a bird's eye view such as that of a photograph. Rather than looking from one position which is vertical over only one place, the orthogonal projection looks at all places from a vertical position. Figure 7.2 shows how the bird's eye view differs from the orthogonal projection, with the difference becoming larger as one moves further from the centre of the diagram. The planimetric map "achieves the visually impossible fact of vertical representation throughout" (Alpers, 1980; quoted in Curnow, 1989: 13). Thus an aerial photograph has many slightly oblique views and only one vertical view, which is corrected to provide a true planimetric view by the application of complex instrumentation. The metric map is everywhere perpendicular, the epitome of the orthogonal, and is often called an *orthographic* map.

Secondly, Keates argues that the map "does not describe or depict individual things, but represents them by signs which place them in classes or categories" (Keates, 1989: 3). Thus the map is distinguished from a picture which represents appearances, depicting individual things and not their *classification* The map maker replaces shapes, shades, colours and gradations with a set of uniform signs and symbols, a system of classification in which the subtle but often important differences between places are ignored and their similarities emphasised.

The first element of the mapped representation of planimetric space, the orthographic perspective, will be contrasted with other perspectives in the following discussion. Later in the chapter the second element, symbolic classification, will be compared to other ways of representing objects, features and events.

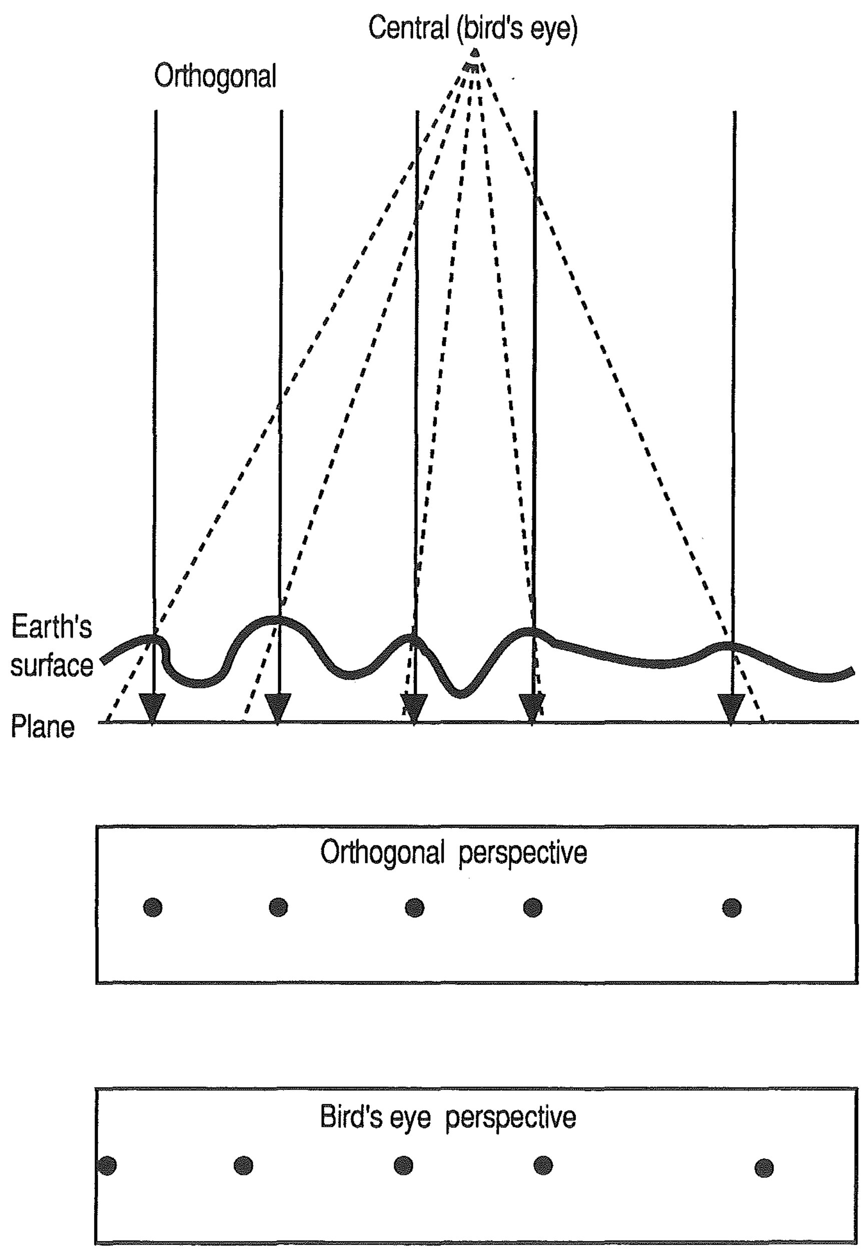


Figure 7.2. Orthogonal and Central (bird's eye) perspectives. Source: after Keates, 1989: 4.

Distorting Geometry

Sack (1980) points out that conceptions of space differ markedly within cultures and between times, as well as between cultures. For the purpose of this discussion some of the more common alternative spatial conceptions in western society will be divided into two coarse groups: those that mathematically *distort* geometry; and those that simply *ignore* geometry.

Closely allied with the development of the orthographic view is the Renaissance revival of *linear perspective*. Both the orthographic view and the perspective view can be traced to classical times, and both were 'reborn' in the service of expansionist Europe in the fifteenth century. Linear perspective is "a way of thinking about observation, a method that harnesses and organises space" (Descargues, 1977: 9). Figure 7.3 shows how Florence, the city from which the revived perspectivism spread, was represented by artists before and after its advent. The first view is rather odd to modern eyes, because it shows more than what could be expected to be seen from one position. The picture lacks the depth, the feeling of distance, that we expect from such a view.

> "The painter... believed that he could render what he saw before his eyes convincingly by representing what it felt like to walk about, experiencing structures, almost tactilely, from many different sides, rather than from a single, overall vantage" (Edgerton, 1976: 9).

The second view offers this overall perspective. This artist's vision was "based on the assumption that visual space is ordered *a priori* by an abstract, uniform system of linear coordinates" (Edgerton, 1976: 7). The whole picture was organised and related to one single vantage point, which appears to the viewer to be as though he or she were standing in the place of the artist. The centre of the universe is the individual looking at it. "All things were reduced to signals received on the retina; all things led to man" (Descargues, 1977: 10). Crucial to the mathematical science of perspectivism as conceived by Renaissance artists and architects is the vanishing point, to which all of the geometry of the picture flowed. This fact was the most significant in a system that was originally considered to contain the secrets of Divine proportion: with the correct application of the rules, man could be master over all. Importantly, linear perspective contravened the basic principle of Euclidean geometry, which is that space extends infinitely in three dimensions. The vanishing point both departed from Euclidean geometry and yet produced the illusion of three dimensions.

Modern developments of the oblique perspective are the Isometric and Axonometric projections, related compromises between the orthographic map and the linear perspective. Perspective drawing has the limitation of foreshortening, in which objects are condensed and obscured at the rear of the picture. The Iso/Axono-metric projections are dimetric graphics, employing two axes and therefore no vanishing point (Figure 7.4). They have proved most popular in representing urban form, both by architects (as in Figure 7.5) and by urban cartographers.

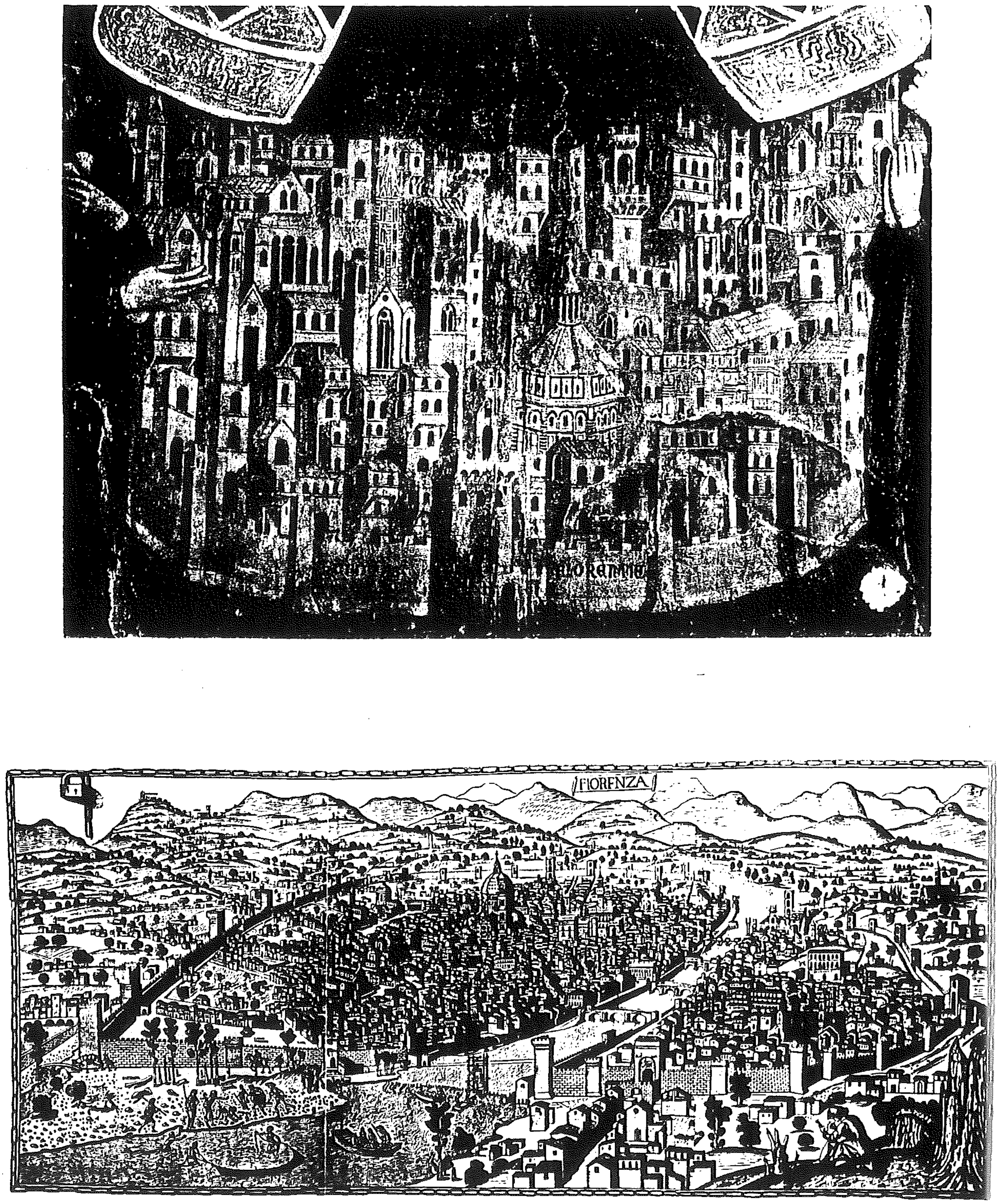


Figure 7.3. Two artistic conceptions of Florence; above, c. 1350; below, c. 1480.
Source: Edgerton, 1976.

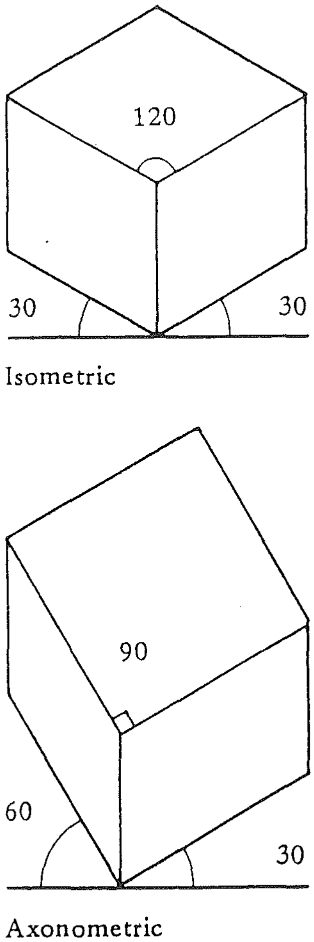


Figure 7.4. Isometric and Axonometric projection angles. Source: Treib, 1981.

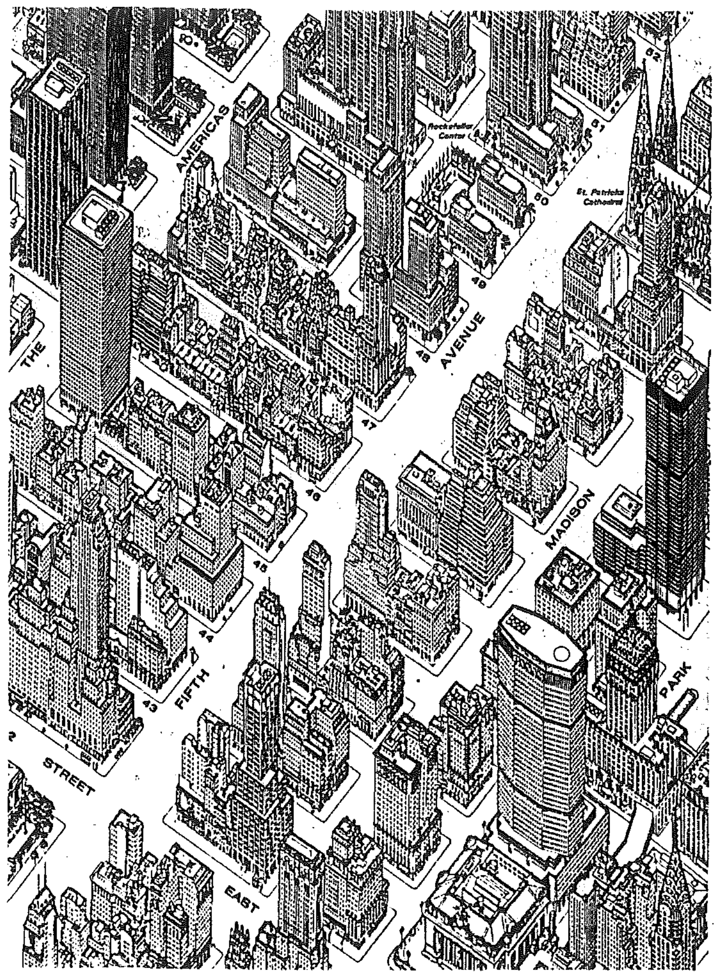


Figure 7.5. Isometric map of Manhattan (detail). Source: Green and Donovan, 1979.

Many geographers have explored *mathematical distortions* of Euclidean geometry. These have generally been attempts to introduce a different metric than physical distance to the map, thereby focusing the map on the metric under discussion, such as time, cost, areal data and so forth. In 1957 Torsten Hägerstrand wrote of a migration study he had conducted in Asby parish in southern Sweden, in which he introduced a logarithmic azimuthal projection on which to present his data (Figure 7.6). Here the reconstitution of localised data does not conform to geographic appearance. Space at the centre of the map is intentionally and mathematically exaggerated at the expense of space compression at the periphery. The increase in scale from the centre of the map is logarithmic in all directions, and was chosen by Hägerstrand to depict short-distance mobility. "This exercise has been constantly quoted, frequently reproduced, but not often replicated" (Chapman *et al*, 1985: 2). The metric of this map, while still being distance-based, depends on the notion of local importance and peripheral irrelevance.

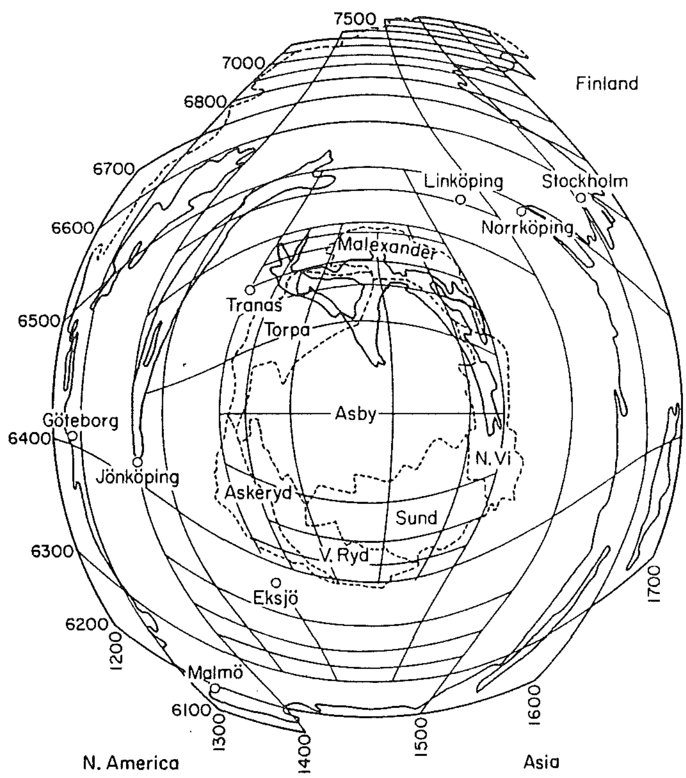


Figure 7.6. Hägerstrand's Logarithmic Azimuthal projection. Source: Chapman *et al*, 1985.

In 1961 a detailed examination of mathematical transformations of Euclidean space was presented as part of a Ph.D. by Waldo Tobler. His basic premise was that to many people in many real-world situations, time or cost are more relevant considerations than is physical distance. This work heralded a number of studies (Janelle, 1968; Ewing, 1974; Baxter and Lenzi, 1975, for example) which explored "the notion of a space defined by separation in time or cost terms, a space which the progressions and regressions of technology make one of continuous flux" (Forer, 1978: 230). In his review of the geographical concept of space, Forer (1978) calls this continuous flux 'plastic space'.

An increasingly common way of portraying areal relationships is the *cartogram*, a map where the area of a geographic unit such as a country or a meshblock is calculated by something other than physical distance, for example population (Figure 7.7). Relationships between adjacent areas are (at least partially) preserved in the cartogram. These maps are generally used to communicate only one message, and have seldom been used as the base metric for more complex communication. Cartograms 'work' because they surprise us by their distortion of size while attempting to preserve familiar shapes.

It is only when Euclidean space has already been accepted as the most basic and fundamental space that terms like 'distorting geometry and 'plastic space' have any meaning. An idea central to this discussion is that, far from being a way of conceiving of space intrinsic to human thinking, Euclidean space is itself a 'distortion' of fundamental spatial conceptions which more closely reflect human cognitive thought.

Ignoring Geometry

There are spatial reconstitutions, not based upon mathematical rigour, which offer close approximations to what psychologists suppose to be cognitive conceptions of space. The closest approximation would seems to be that of *cognitive* (mental) maps: schematic maps typically drawn by respondents to questions such as "draw a map from your memory of city *x*." Some writers have argued in reviews of these maps that they can identify systematic 'distortions' or 'errors' in geographic location and orientation, which are common to many of the subjects of their experiments (Stevens and Coupe, 1978; Sadalla, Burroughs and Staplin, 1980; Tversky, 1981; Buttenfield, 1986).

Attempts are made to quantify such errors and distortions (Figure 7.8), without asking whether the subjects are instead attempting to portray a space that is neither Euclidean or (in the narrow sense) geographical. The arguments upon which much of the work examining mental maps is based beg the question of to what degree a representation of cognitive space is a memory of a Euclidean image.

Gould and White (1986) show that reconstitutions of cognitive spatial images depend on much more than a notion of physical distance. They note that people exaggerate their own towns and locations they know well, not because they actually believe that these are larger than those they do not know, but because they wish to emphasise what they do know. The relative 'size' of places on a cognitive map may be a function of emotional involvement, patriotism, economic need, ignorance, fear, preference and prejudice. These are the stuff from which cognitive space is constructed and, while each is to some extent influenced by physical distance, these factors in all probability have a greater influence on everyday human decision-making and life than does the notion of strict Euclidean relationships which humans are supposed to distort.

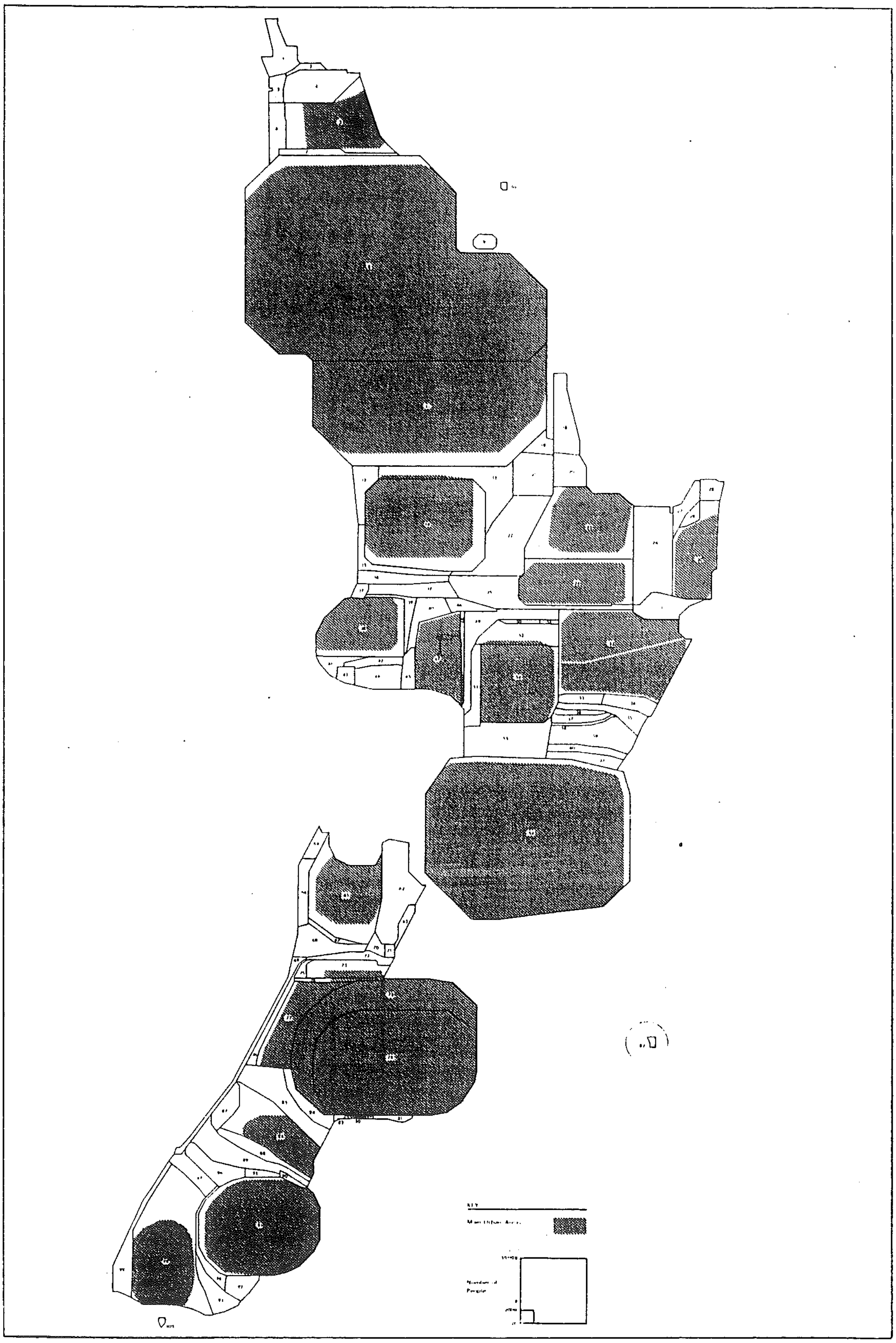


Figure 7.7. A contiguous-area cartogram of New Zealand. Source: Kelly, 1987.

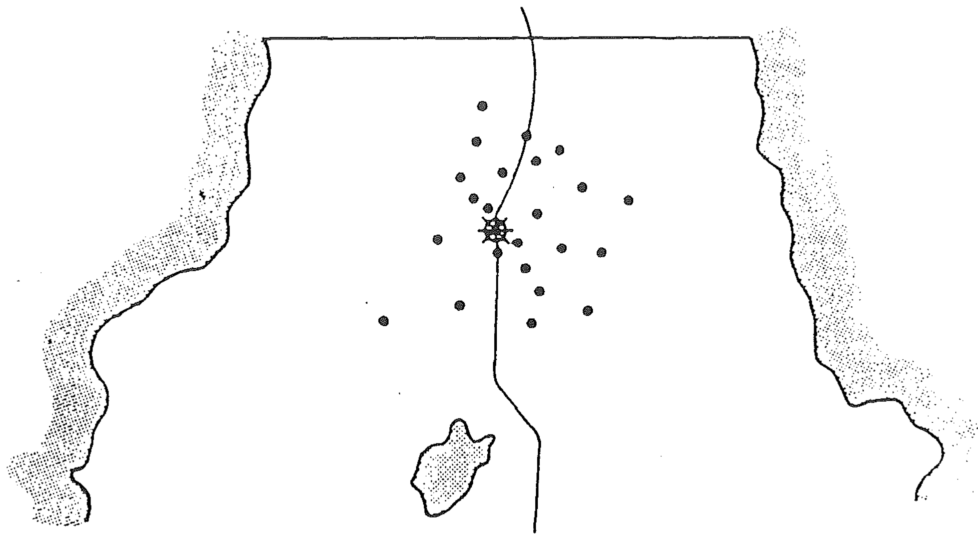


Figure 7.8. Mislocation of a large shopping centre, taken from cognitive maps.
Source: Buttenfield, 1986: 243.

The greatest advantage of cognitive maps is also their greatest handicap. Mental maps give a meaningful insight into the life and thought of the subject, enabling her or him to put down on paper a series of inter-relationships not easily constructed in any other way. Typically, however, there are few of the common reference points on these maps necessary for meaningful communication. While offering excellent insights, they can in virtually no way be used by the map maker to communicate information of general relevance. The widespread use of these maps would bring cartography perilously close to anarchy. From them, however, can be gleaned the insight that schematic maps may both simplify a complex reality along lines personal and familiar to the subject, and bring back into clear focus the space that is important to the subject.

The dual principles of simplicity and clear focus are best demonstrated by that acclaimed classic of design, the London Underground Map (Figure 7.9). This graphic informs the public while both promoting and unifying a diverse and complex transport system. By ignoring geography to the extent that the only surface feature provided with which to orient the rail system is the River Thames, this schematic map enables the designer to focus on the message to be communicated while excluding elements that distract or intimidate the reader. As shown in Figure 7.10, Euclidean geography has been bypassed in the distance relationship between the stations and lines, a system which bears no mathematical relationship to that of Euclidean space. Compared to a planimetric map of the London Underground, this schema is of a much larger scale in the centre, where the stations and lines are most concentrated, and is smaller in scale near the periphery. This enables the reader to see clearly the central section of the system and make more accurate estimations of time distance than from a planimetric map.

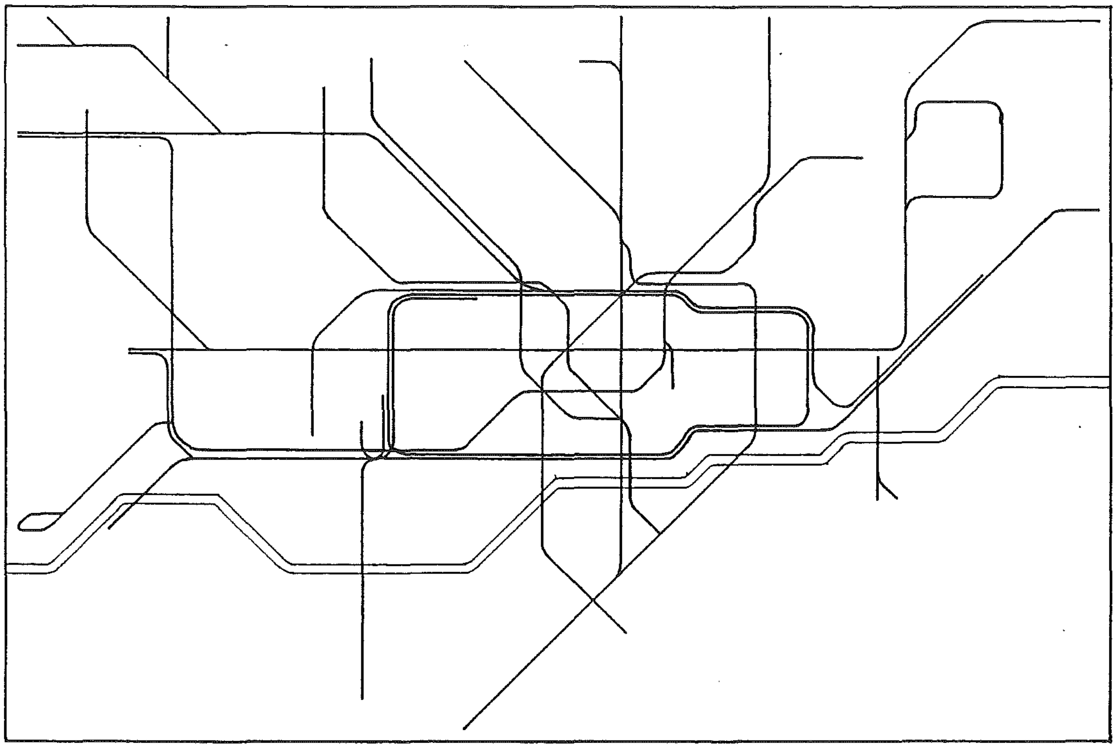


Figure 7.9. The London Underground map.

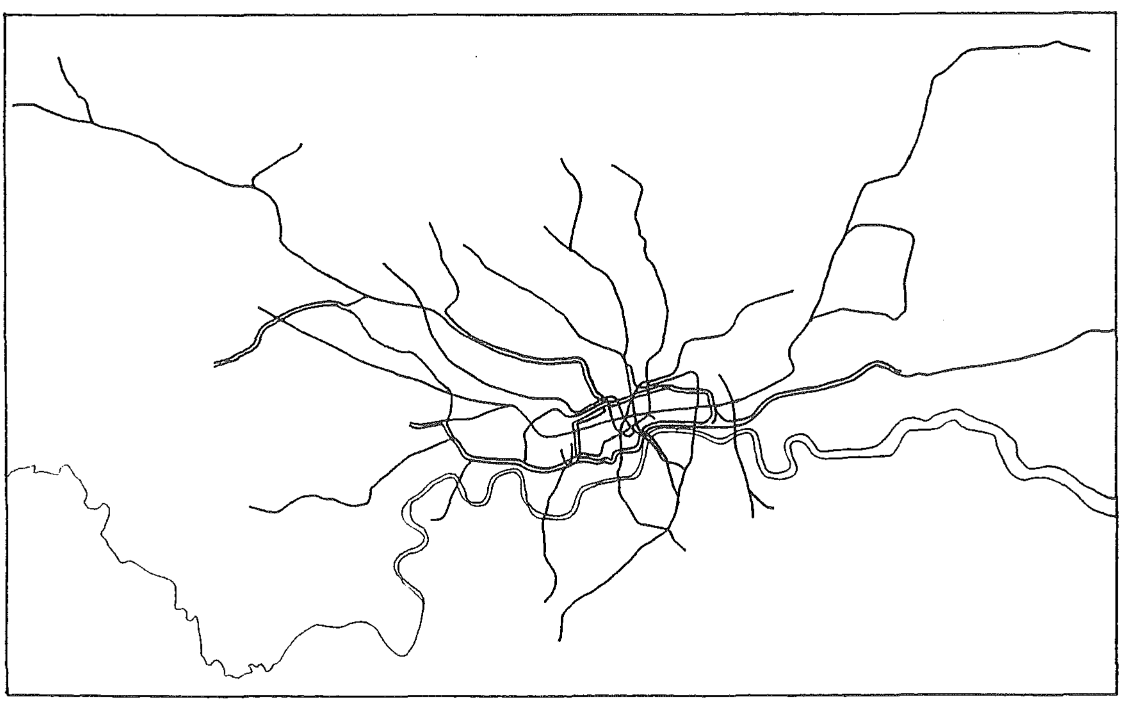


Figure 7.10. The London underground network mapped using Euclidean space.

Rejected when first proposed because the management found it "altogether too strange and revolutionary" (Design Classics, 1989), the map was eventually given limited circulation amongst a grateful public. The map served London Transport well in the 1930's when they sought to convince people to travel on the system more frequently by suggesting that the terminuses were relatively close. However far people lived from the centre, they could still feel like sophisticated Londoners exploiting the pleasures of the capital. "For many people", commented the narrator of Design Classics, which featured the London Underground Map, "the map is the best representation of London they have". This is because, unlike so many other maps, this schematic diagram actually works. A professor of graphic art was moved to say that the map was "extraordinarily lucid" and "almost impossible to improve." As the narrator says, Harry Beck's design works because it "ignores geography. Somebody had me in mind" (Design Classics, 1989).

Procedural Space

A common pattern can be discerned in many of these alternative spatial reconstitutions, one which when distilled reveals a way of representing space more fundamental than that of Euclidean geometry. This spatial representation is *procedural space,* defined in this thesis as *a system of spatial organisation, incorporating elements of both space and time, which leads one from a defined starting point towards a particular objective.* The following discussion elucidates this definition.

Rather than conclude that subjects systematically distort a Euclidean reality, psychological researchers might do better to contend from their investigations that humans perceive their environment in recognisably patterned ways. This is the approach taken by Thorndyke and Hayes-Roth (1982) who point to a clear distinction between *procedural descriptions,* typically derived from direct navigational experience or descriptions of such comprised of a sequential record of elements of the space between starting point and destination, and *survey knowledge,* an assessment of the topographical features of an environment including relationships between objects and an external position-fixing system determined by Euclidean distances, derived from maps and photographs. This research is pre-dated by Siegel and White (1975) and Evans and Pezdek (1980). The latter wrote:

> "When one studies a map... one learns the relative locations of geographic elements from one perspective. When we learn the

> location of objects in a highly familiar setting, we continually experience the environment from multiple perspectives" (Evans and Pezdek, 1980: 23).

The research suggests that different results, in the form of cognitive knowledge and subsequent spatial actions, can be anticipated from the different ways of acquiring spatial knowledge. These results are influenced by the different *perspectives* presented by these learning procedures. The idea of perspective is central to the notion of procedural space.

As established above, orthographic maps based on Euclidean geometry adopt one strictly defined perspective. Thorndyke and Hayes-Roth refer to this as the 'canonical vertical view', in which "the individual views... from above and outside of the depicted space" (Thorndyke and Hayes-Roth, 1982). The position of the viewer is crucial:

> "People tend to look "up and out" at their earth surroundings in the course of their daily lives, but the use of maps allows them to look "down and in" at these same features of our environment" (Muehrcke, 1974: 13).

This vertical perspective is quite foreign to the experience of most people. Instead, during the daily activity of moving about the environment, an individual acquires procedural knowledge made up of "observed features in the environment and action sequences performed to navigate between locations" (Thorndyke and Hayes-Roth, 1982: 563). The individual's perspective corresponds to the horizontal perspective he or she has during navigation. He or she is in the picture, looking out; while the map reader is out of the picture, looking in.

This difference in perspective is crucial in understanding how maps have shaped contemporary western environmental decision-making from a perspective not shared by most people.

> "Conventional map projections do not guarantee that the spatial parameters of the resulting map will bear any resemblance to man's cognitive space, with the result that "logical" map reading can easily lead to irrational conclusions concerning human spatial behaviour. Or, conversely, policy decisions based on conventional map reading may invalidate the basic humanity of planning efforts." (Muehrcke, 1974: 13).

Examples of deleterious consequences of inhuman planning are not difficult to find. The present author reports on one such case which arose as he was writing this chapter.

I went to visit my parents this last Christmas Eve (1990). Driving down Breezes Road towards the intersection closest to my childhood home, I saw a sandy desert where a row of shops and a service station had been. These buildings had been a part of my childhood horizon, constantly changing names but always there. It was all my mother could talk about: the hole in the landscape and the new service station that was to be built. The heart had been ripped out of the commercial centre she inhabited every day. The wasteland is visible from her front gate, in her view an inglorious perspective invested with a nostalgic sorrow. The people who tore down the old buildings did so not after having viewed them from my mother's front gate, but after getting instructions from others who consulted a city plan and decided that the commercial zoning on a major arterial route due for widening provided an ideal place to put that service station they'd been talking about.

A perspective is literally a view of objects from a specific place giving some impression of the relative positions and magnitudes of those objects (Concise Oxford Dictionary, 1976). Figuratively, it is also a point of view, a way of seeing not just 'the facts' but the emotional magnitude and position of those facts relative to the perceiver's stance. My mother has a different literal and figurative perspective on the events at her local corner than do those who generated the changes there. She sees things historically and horizontally, while they see them geographically and vertically.

Muehrcke argues that perspective is crucial in environmental decision-making:

> "Mapping environmental phenomena planimetrically and at greatly reduced scale may well abstract that informational attribute which is most crucial in related policy formulation and decision making. This is especially true in terms of aesthetics as, for example, in the case of our ugly urban landscapes, since the "birds-eye" map view is not what we see when moving about at ground level" (Muehrcke, 1974: 13).

Janos Szego (1987) presents a diagram that illuminates the idea of perspective, helping illustrate how the vertical and the horizontal perspectives are aligned with space and time (Figure 7.11). Szego argues that there are a number of ways of looking at the material world, each of which involve degrees of space and time. If we wish to scan the earth in order to determine the geometric position of various features on its surface, generating the relative geometric relationships of all of these features, then our scanning must be disconnected from the continuous flow of events which modify these relationships. That is, our map-like, geometric view must be a 'snapshot', eliminating the time element. "We gain geometric precision at the cost of knowledge about the position of the elements in a time sequence" (Szego, 1987: 27). This perspective is symbolised by arrow 'A' in Figure 7.11, which is perpendicular to the plane of the model's surface. It is a *chorological* view from a planimetric perspective, the very view that generates orthographic maps.

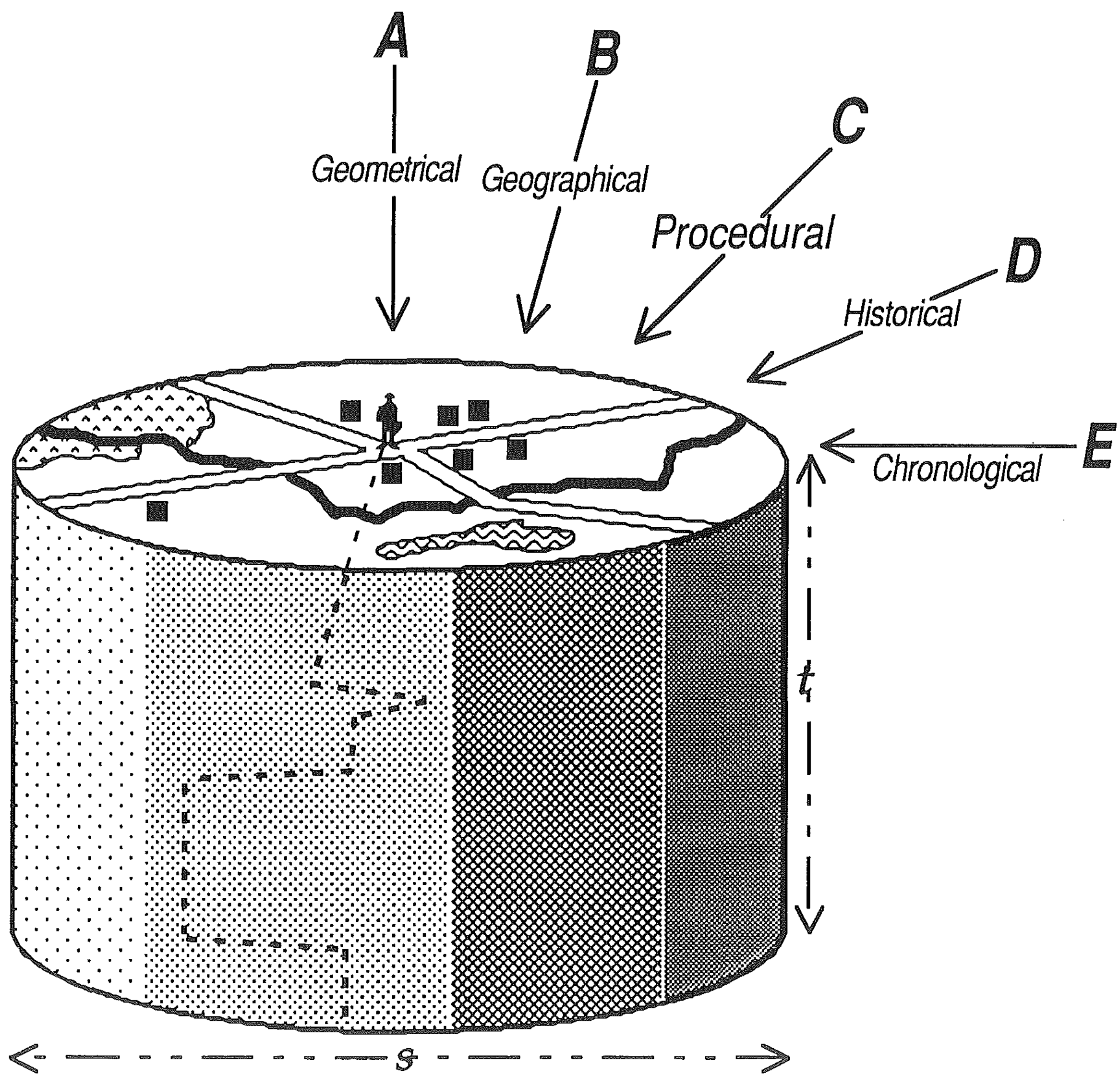


Figure 7.11. Representing time and space. Source: after Szego, 1987.
NB: the dotted line is a path through time and space (a procedure).

This first perspective is at one extreme end of a continuum of views. At the other end, not unnaturally, is the perspective that minimises the space element, where events through time are observed. In this view an event can be traced from its beginning to its end, and the relationships between events in time can be pieced together. Where these events occur is of minor importance. This kind of perspective was pioneered in geography by the Lund school, from which Szego has derived his work, and is shown on Figure 7.11 as arrow 'E'. It is a *chronological* view.

These extreme views symbolise the difference between the geographical and historical interpretation of things (called 'features' by geographers and 'events' by historians). Realistically, however, no competent historian could attempt to understand the inter-relationships between events without assessing where these events have been located, nor could a geographer gain a sensible understanding of the earth's features without discovering something about their history. Although the primary perspective is spatial, an element of time must be included in the *geographical* perspective (arrow 'B' on Figure 7.11). Similarly, the chronological perspective must be leavened by a spatial component in order to be a truly *historical* perspective (arrow 'D' on Figure 7.11).

People live in both space and time, each of which may assume primary importance at various places and times. This shifting compromise can be symbolised by arrow 'C' in Figure 7.11. It is an arrow not labeled by Szego but called the *procedural* perspective by the present author, invoking the idea of a task such as navigation that involves both the space and the time component. It is an oblique view, midway between the vertical and horizontal perspectives of maps and daily experience respectively.

It must be emphasised that any perspective, including all of those discussed by Szego, can represent phenomena procedurally. With the addition of text or other graphics to highlight the procedure (where to start and where to finish), a Euclidean map can be said to be procedural. The obvious example of this is a treasure map, with 'x' marking the spot and perhaps a dotted line leading from 'you are here' to 'x'. However, it is argued in this present discussion that *because a procedure involves the time dimension, the closer a perspective approaches the horizontal, the more procedural that perspective has the potential to be.* The oblique perspective is an excellent compromise space/time perspective.

Szego has found an excellent example of a map graphic that attempts to portray the interactions of events and features over time and space (Figure 7.12). Notice how the view itself is neither vertical nor horizontal, but is oblique, like arrow 'C'. The graphic invokes a feeling of depth, of movement, and the perspective and orientation of the map allows the viewer to almost 'insert' him or herself into that movement, which flows from the bottom-centre of the map upwards, left and right over Europe. It is a much more effective way of communicating a dynamic series of events than either a chorological or a chronological view (see Figure 7.12).

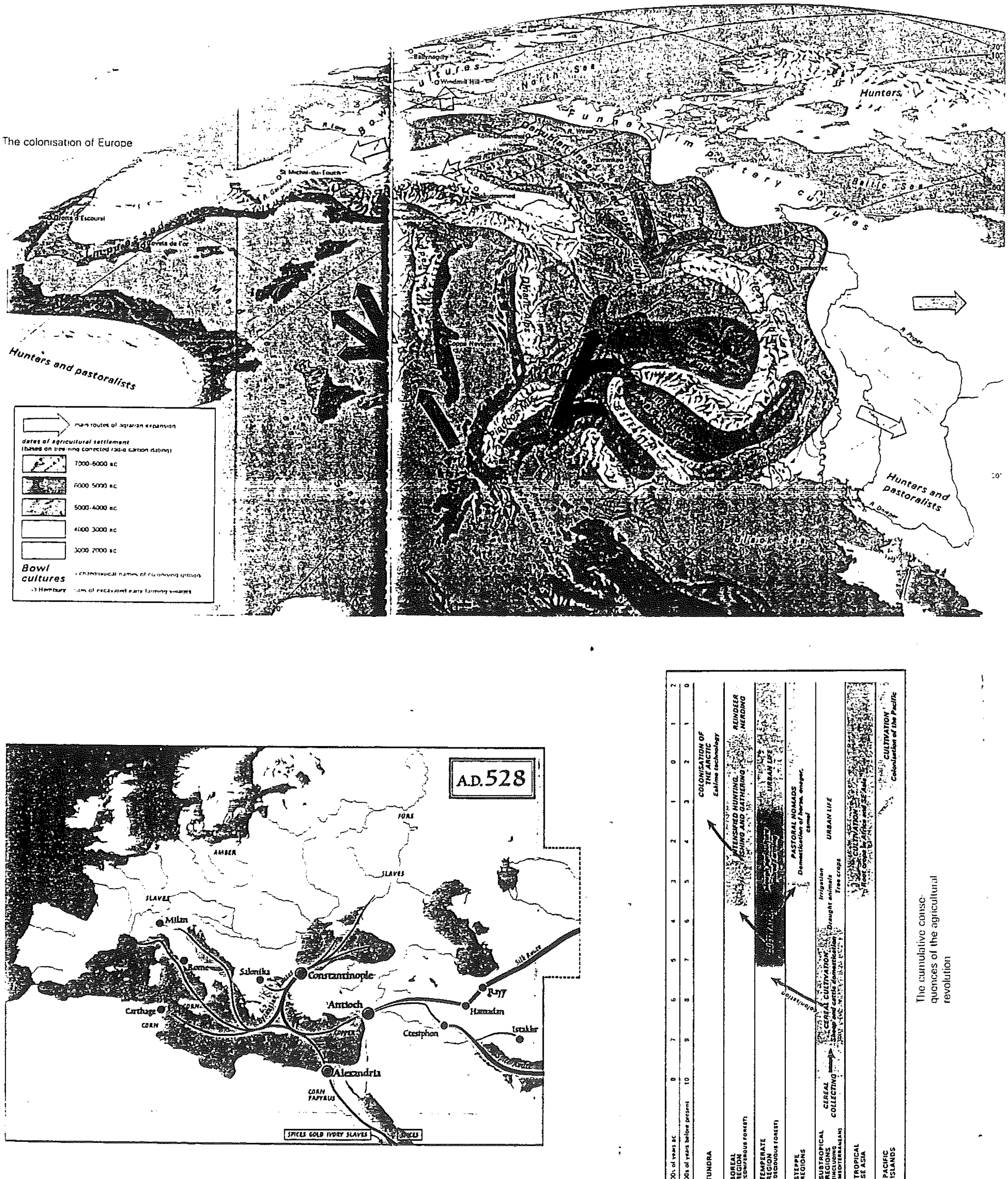


Figure 7.12. Oblique procedural, chorological and chronological views of Europe. Source: Szego, 1987.

Some graphic designers and cartographers have used these principles, perhaps knowingly, perhaps intuitively. Don Appleyard, Kevin Lynch and John Myer (1964) produced a proposal for ameliorating Boston's traffic problems in the monograph The View from the Road, in which they present their procedural information from chorological, chronological and oblique perspectives (Figure 7.13). The latter two of these perspectives are strikingly procedural in nature.

Figure 7.14 is a map of central Brisbane designed for use during Expo 88, and sold at booths located at the Expo site. The map offers an oblique procedural perspective oriented so that the Expo site is at the bottom, literally nearest the reader so that people can 'insert' themselves easily into the graphic, from whence they can proceed into Brisbane. Complex navigational tasks can be solved using this map, the map not only communicating effectively but allowing its users to make inferences for themselves. A burgeoning number of this type of map exist, primarily for the built environment (Figure 7.15). Note how informal they are, betraying how amenable this perspective is for conveying information important to people in a relevant manner.

The oblique procedural perspective appears even when people are asked to draw their own maps. Figure 7.16. is a map of one person's home environment, a farm on the outskirts of Lyttelton, the port of Christchurch. The sketch map is interesting in that it is most overtly oblique in perspective closest to the home of the mapper, with more planimetric elements taking over further from his home environment. The smaller map, locating his home in a wider context, is wholly planimetric in form.

From this example it is suspected that *scale* is a significant factor in the appropriate type of reconstitution. Areas of direct personal experience are most easily represented procedurally. Larger areas, not able to be apprehended at once by direct experience, are coordinated into a planimetric view. There may be a threshold or transition zone within which a change in people's spatial perception from horizontal to vertical takes place. Thorndyke and Hayes-Roth give this intuitive example:

> "Point to the Statue of Liberty from where you are sitting. Now point to the local airport from where you are sitting. These tasks illustrate the use of different types of spatial knowledge to compute an orientation judgment" (Thorndyke and Hayes-Roth, 1982: 560).

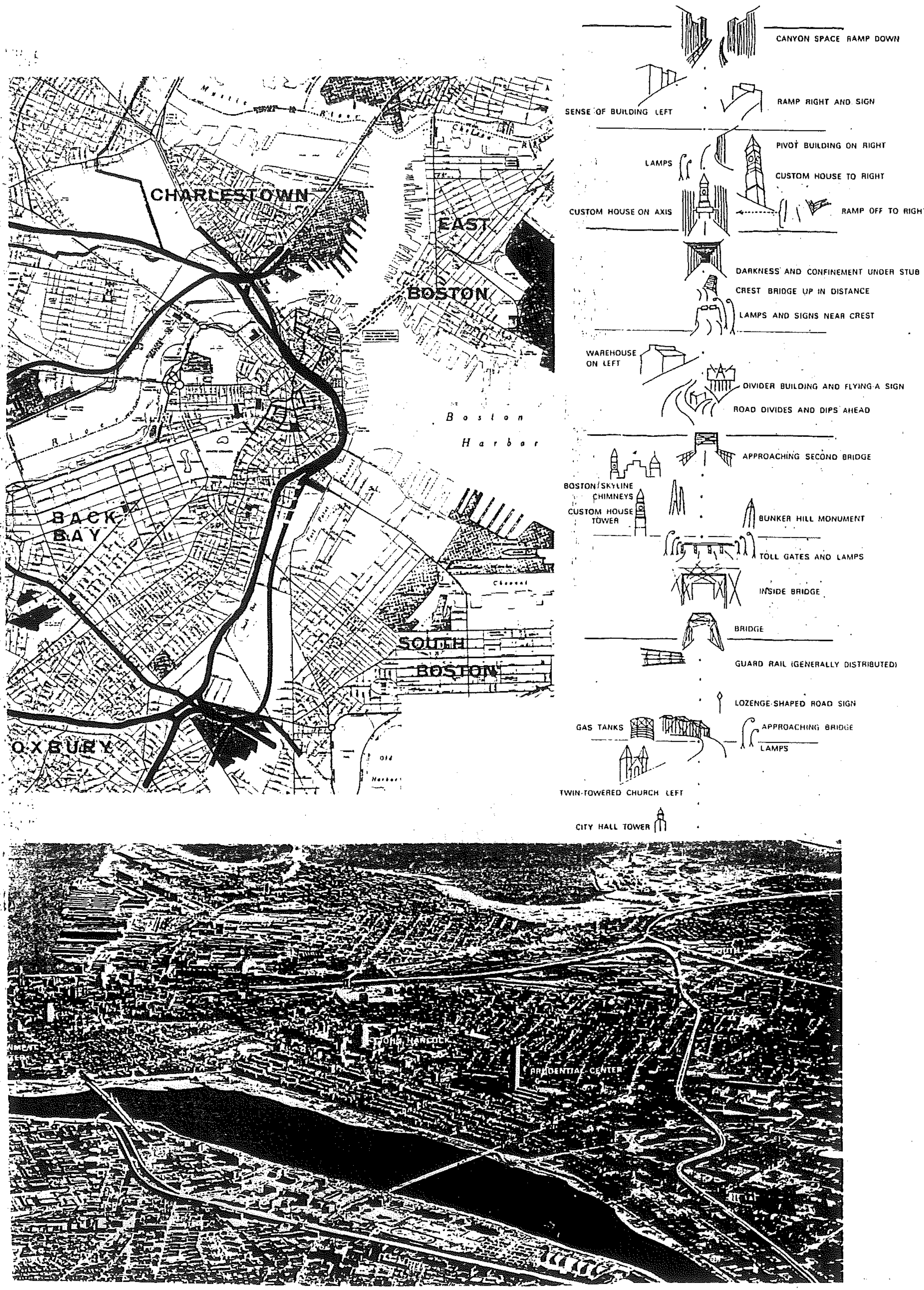


Figure 7.13. The chorological, chronological and oblique views from the road.
Source: Appleyard *et al*, 1964.

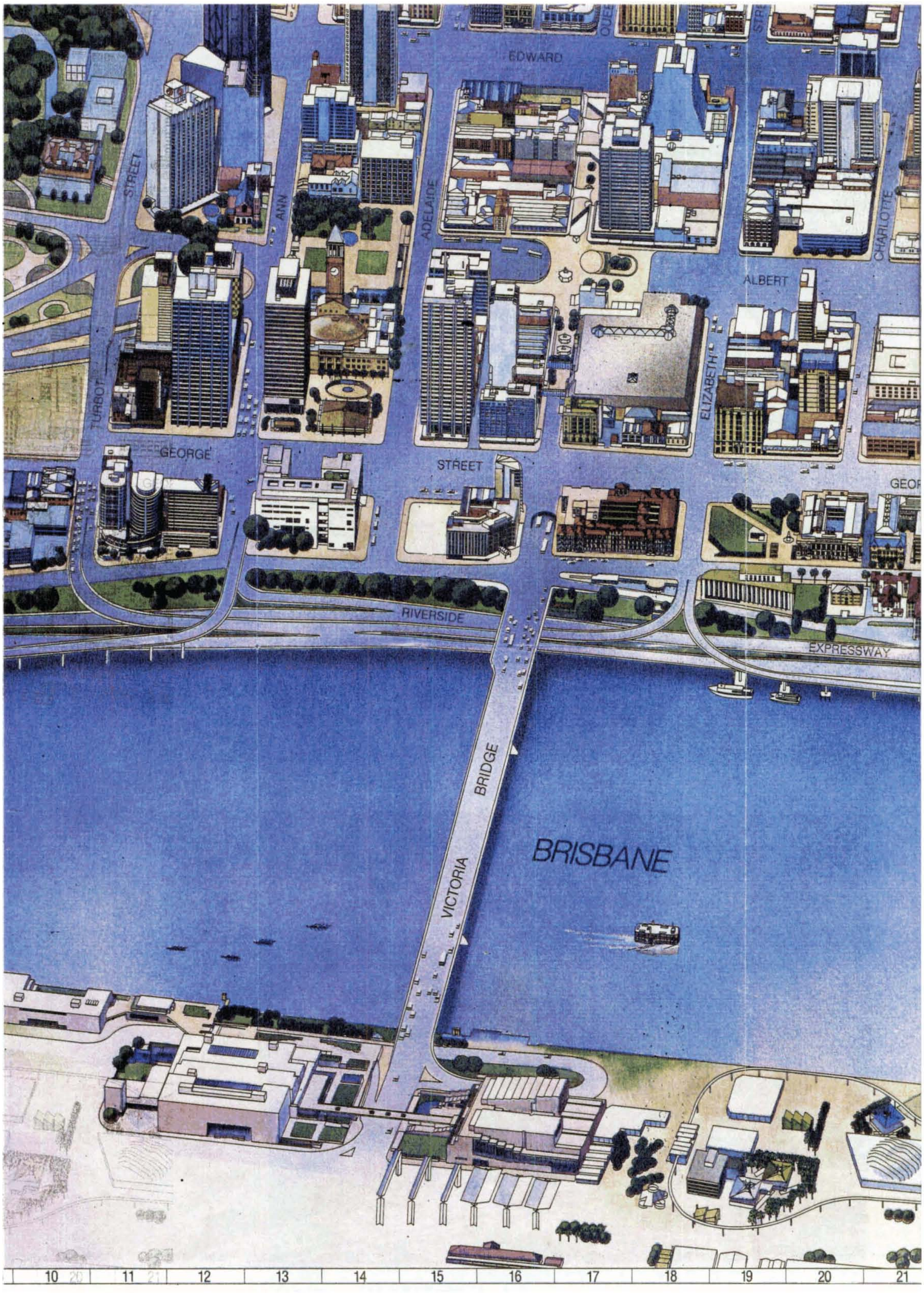


Figure 7.14 Brisbane Expo '88 oblique procedural map.

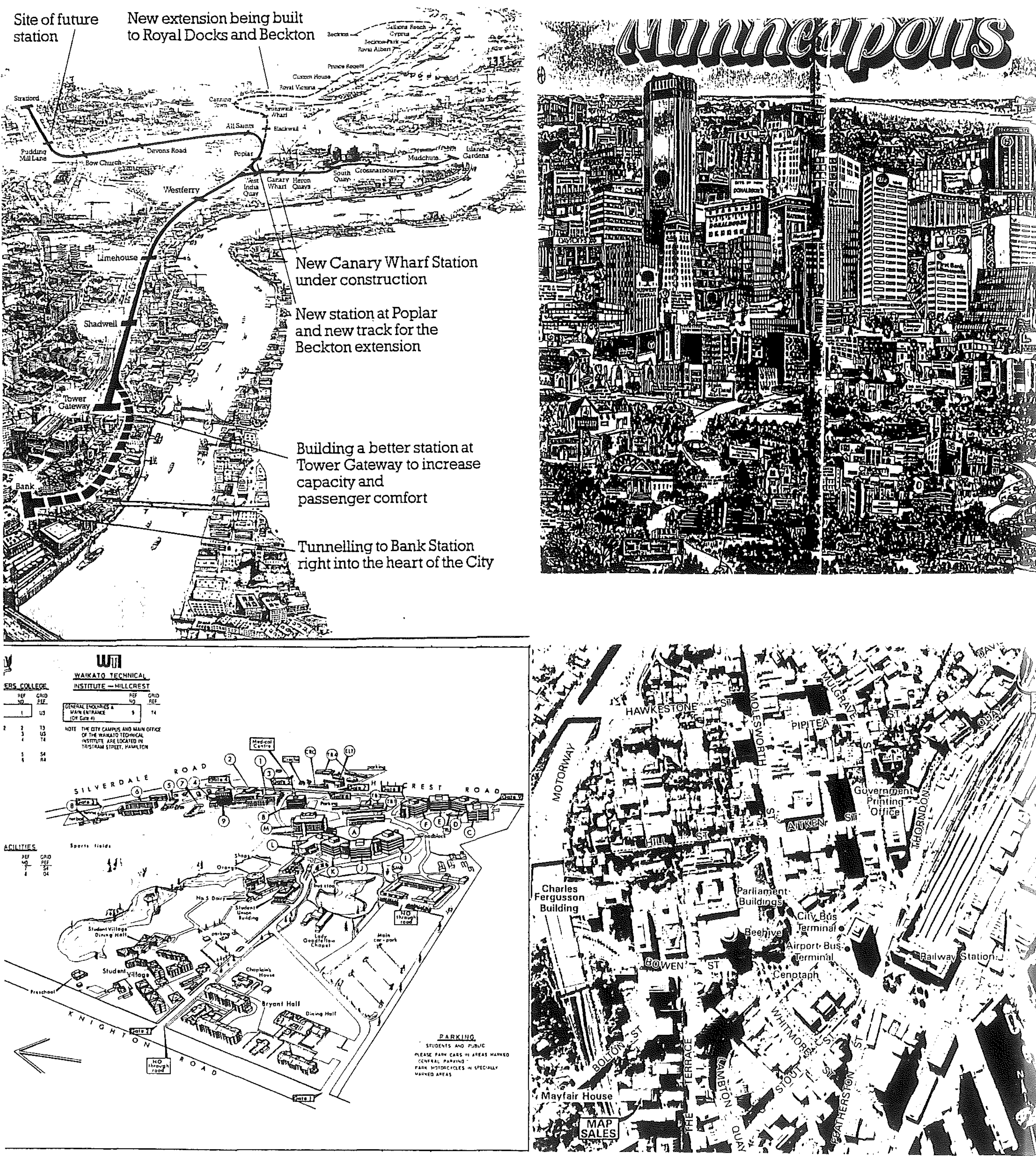


Figure 7.15. A selection of procedural maps. Clockwise from left:

- Extensions to the Docklands light railway, London; Information pamphlet.
- Minneapolis City Character print, Archar Inc., Toronto, 1980.
- Location of premises in Wellington, Department of Lands and Survey, Wellington.
- Hamilton tertiary institutions location map.

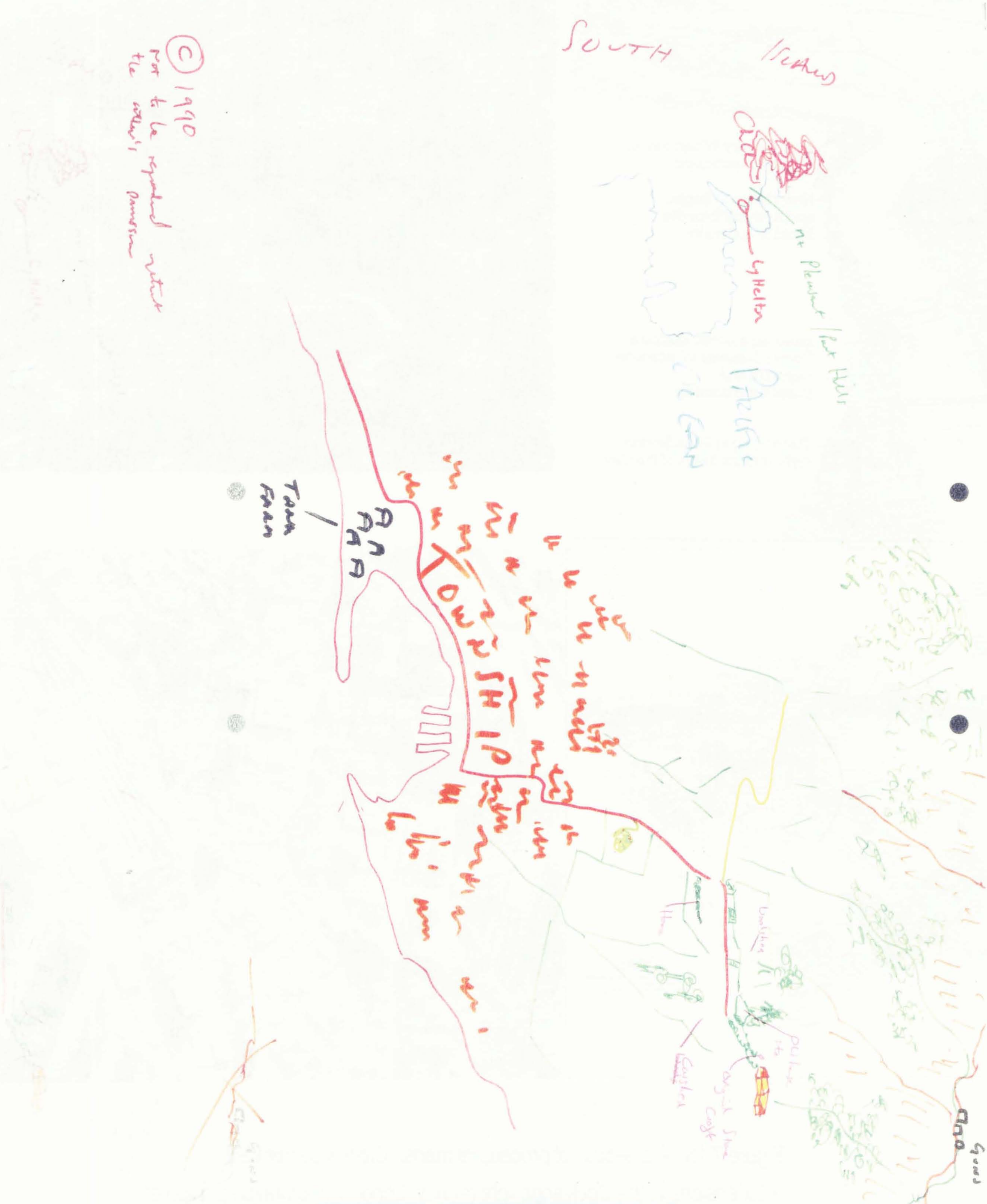


Figure 7.16. Sketch map of one person's home environment.

The authors suggest that the first task involves using a mental image of a U.S. map to estimate the direction of the Statue of Liberty. In contrast, most people use their personal knowledge of the route to the airport, visualising sections of it in their mind, to complete the second task. Simply stated, information from one's own experience may be represented differently to that which received from others. An individual's experience is usually limited in scale compared to the combined experiences of those who provide other spatial sources. Szego comments:

> "The maps often cover large territories which a person could only experience by extensive travel or by observing them from an aeroplane or satellite. In contrast, direct, personal perception of the landscape occurs when one can behold smaller, more limited portions of the landscape" (Szego, 1987: 38).

Szego finishes his discussion of scale by suggesting that a *pictorial* map is easy to experience because it fits together small and familiar segments of the landscape.

Szego's comments introduce a further factor in reconstitution. Thus far attention has been paid to the form of the map base, the first of Keates' assertions as to what makes a map. His second was symbology, or how elements of the landscape were to be represented, and his argument was that maps generalise to the extent that they depict classes of things rather than individual things themselves. How are they to do this? Phenomena can be represented on maps on a continua between two extremes: the *arbitrary* and the *mimetic* (Figure 7.17.). Arbitrary symbols (called by Keates diagrammatic) are not intuitively recognisable: one must refer to a key to discover what objects they represent. Mimetic (pictorial) symbols are more iconic in nature, often being a representation of one typical individual in a class of objects.

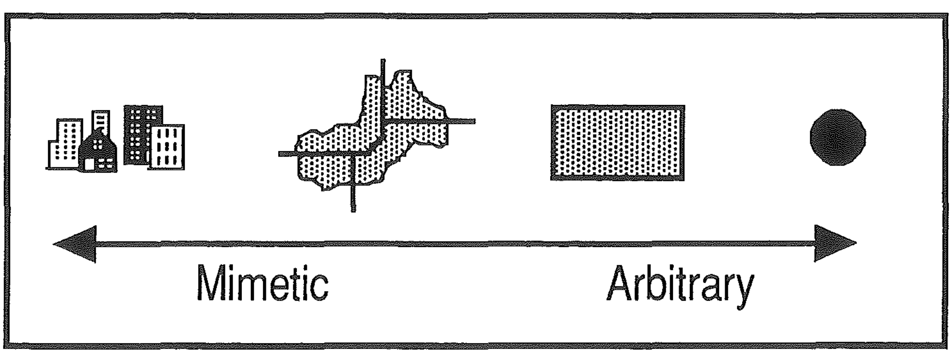


Figure 7.17. An example of the mimetic-arbitrary continuum in the representation of cities. Source: after Robinson and Petchenik, 1976.

Jeffrey Murray argues that by representing classes of phenomena pictorially the cartographer often (and sometimes intentionally) misrepresents their importance. For example, it is easy to use symbols to make an area appear more resource-rich than it is in reality. The use of arbitrary symbols would allow a more accurate depiction of the areal extent of the resources.

While this is true, the use of arbitrary symbols to depict objects familiar to humans is another example of an abstraction that may decrease the relevance of the map - by making it harder to process - for some people. Where a map needs to be particularly easy to interpret, such as the base map for an oil pollution simulation game designed for children, mimetic symbols are often favoured (Figure 7.18). Simply stated, all symbols misrepresent their referent objects to a degree.

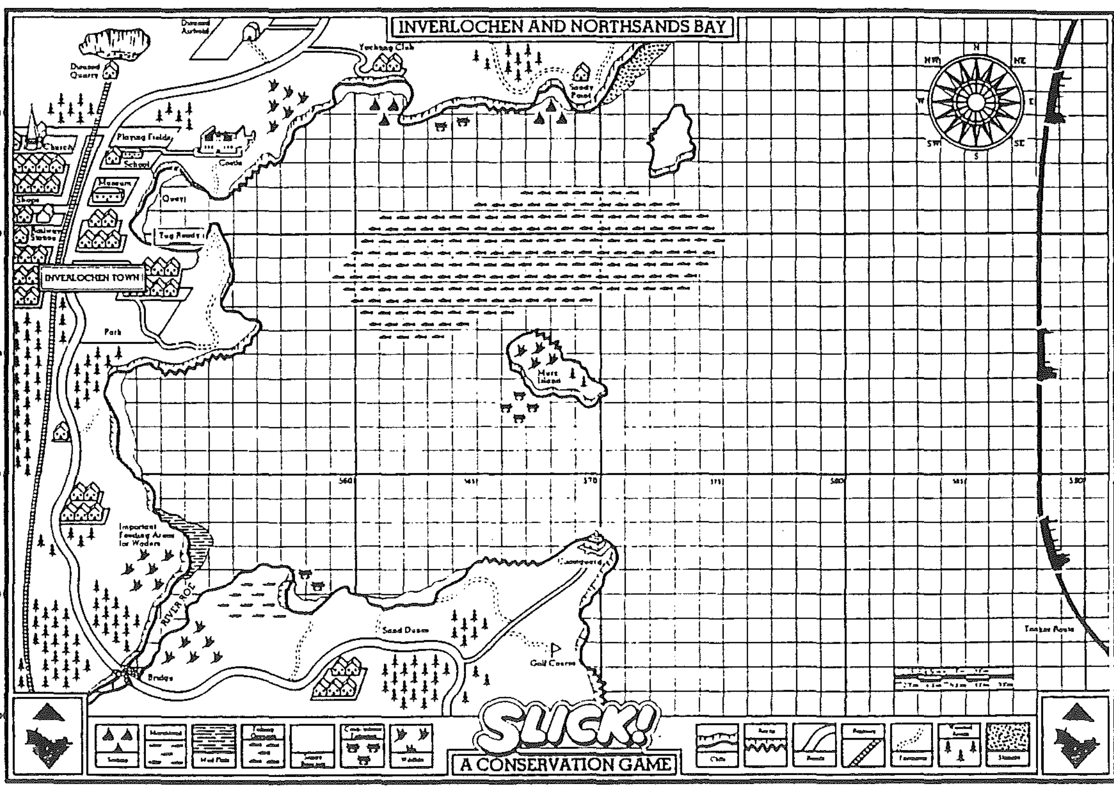


Figure 7.18. The base map for an oil pollution simulation game. Source: Maguire, 1988: 126.

It could be argued that the use of arbitrary symbols on maps may lead decision-makers and planners to forget or misinterpret the character of the original object. The transformation from referent object to arbitrary map symbol may divest that object of its essence or humanity. Muehrcke (1974) suggests that a primary reason for the misinterpretation and abuse of maps is the combination of abstractions produced by representing spatial data planimetrically and arbitrarily. This common type of reconstitution "... casts doubt on the essential understanding and compassion associated with planning and policy decisions made via map study", leading in his view to "... dehumanising treatment of ourselves [and] the desecration of the environment" (Muehrcke, 1974: 18, 20).

This section has argued for a more flexible reconstitution of spatial data. It can be argued that the interpretation of the content of any map depends on the point of view from which it is reconstituted. The history of western cartography has been one of privileging the vertical view over other perspectives of the world, some of which, in specific situations, may be far more effective. But what of the spatial conception of non-western peoples? A brief study of some of these alternative views brings further illumination to the topic.

Spatial Reconstitution of other Cultures

Perhaps the greatest device to humanise a landscape, and the maps based on it, is nomenclature. Humans have a habit of naming things, the landscape of New Zealand being no exception. Pakeha (non-Maori) names were given to the landscape from 1640 onwards, their number gaining momentum with increases in the volume of settlement until reaching a crescendo in the nineteenth century. These names were a way of 'Europeanising' the land, making a strange and vastly different country into an echo of home. Yet, in most parts of the country, Pakeha names are outnumbered by Maori names as recorded on official maps. This is in spite of the fact that the majority of Maori names have been 'lost' - that is, not recorded in written form. Johannes Anderson records the thoughts of an early missionary on the abundance of Maori place names:

> "Few races have been so prodigal in their bestowal of local names. Every peak, saddle, knoll, and spur; every bend, rapid, and pool in stream; every creek and bay, beach and headland has its name, as well as every mountain range, river and sea. pas and camping grounds, battlefields, fishing grounds and landing places, sites of eel-weirs or bird-snares - all were well-known by their own particular names; it is much to be regretted that the vast mass of these names has been allowed to pass into oblivion" (Andersen, 1942).

The volume of these names is explained by their function. While Europeans depended upon maps and charts to navigate around their new possession, the Maori used the names to navigate. "The meaning of many Maori names... can only be understood through their connection to other names and other places" (Introduction, Maori Oral History Atlas, 1990: xiii). A series of names were strung together in the memory of an individual, hapu or tribe, commemorating the journey of an ancestor or a series of traditional events, and serving also to mark the route for anyone who wished to travel in that path. These routes were linked together in what contemporary Maori scholars have called *oral* maps (Figure 7.19).

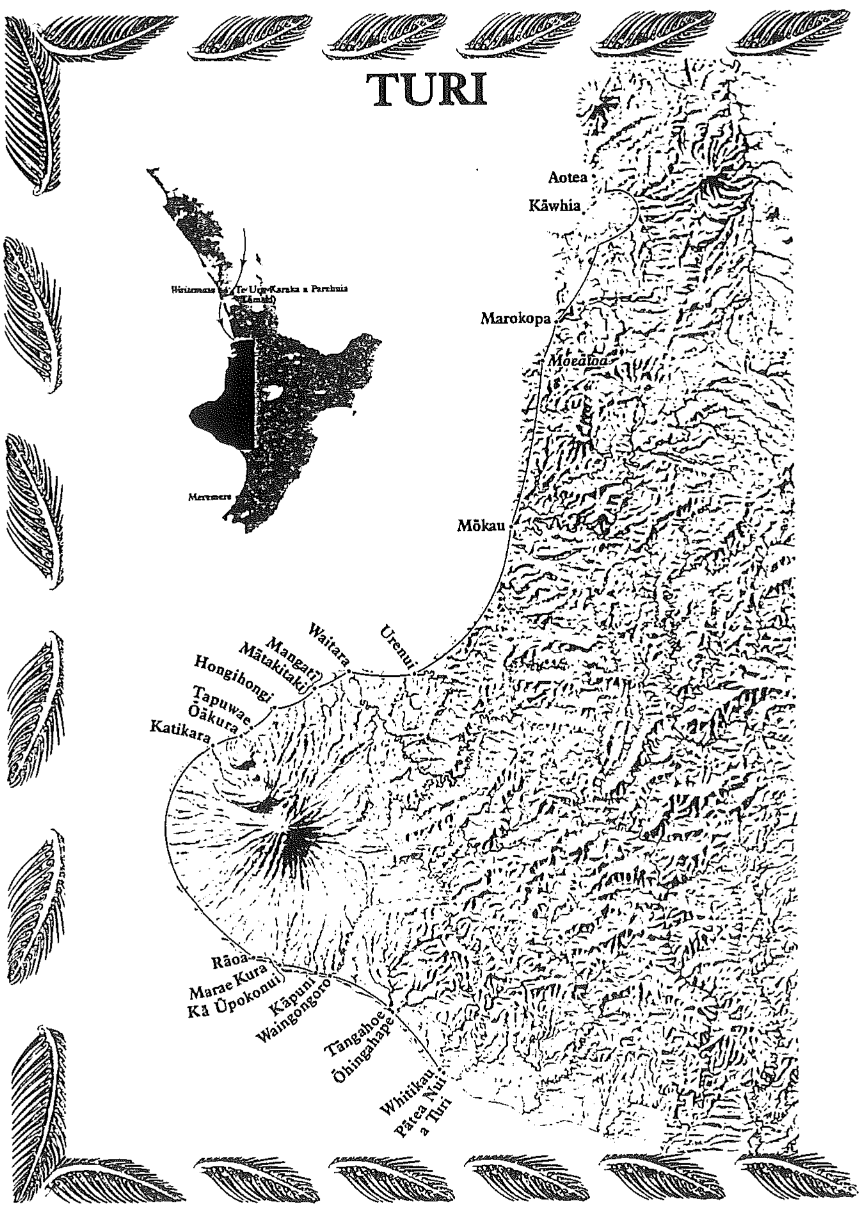


Figure 7.19. A graphic rendering of a Maori oral map. Source: New Zealand Geographic Board, 1990.

These groups or lines of names released vital parcels of history and geography to those who learned them. "The names in the landscape were like survey pegs of memory" (Introduction, Maori Oral History Atlas, 1990: xiii). Significantly, when Pakeha scholars like Eldson Best or Johannes Andersen gained an interview with a kaumatua or other tribal elder, the names they were given came in a specific order, following a coastline or river valley. By the time of European settlement the Maori were able to travel the length and breadth of the country on foot and by canoe. Ironically, the 'discoverers' of trans-alpine routes like Arthurs' and Haast passes were led by Maori guides.

The Maori experience of geography was procedural; that is, they experienced space through time, like all humans do. However, unlike western peoples their recording of space is also procedural, with the oral maps serving as itineraries of their journeys through space and time. "The story explains and orders the geography and the land geography reinforces the history" (Introduction, Maori Oral History Atlas, 1990: xiii).

The aboriginal people of Australia use a similar system, perhaps even more sophisticated due to the harshness of their environment. These strings of names are remembered by being sung, and are referred to as *songlines*. In the mind of an Australian aboriginal who knew the songlines, the landscape would be criss-crossed by these lines of geographical, historical and spiritual significance, created by the journeys of the ancestors. In his book set in the Australian outback, Bruce Chatwin described the songline this way:

> ""Certain phrases, certain combinations of musical notes, are thought to describe the action of the Ancestor's feet. One phrase would say, 'Salt-pan', another 'Creek-bed', 'Spinifex', 'Sand-hill', 'Mulga-scrub', 'Rock-face' and so forth. An expert song-man, by listening to their order of succession, would count how many times his hero crossed a river, or scaled a ridge - and be able to calculate where, and how far along, a Songline he was.
>
> ""He'd be able", said Arkady, "to hear a few bars and say, "This is Middle Bore" or "That is Oodnadatta" - where the Ancestor did X or Y or Z."
>
> ""So a musical phrase", I said, "is a map reference?"
>
> ""Music", said Arkady, "is a memory bank for finding one's way about the world"" (Chatwin, 1987: 120).

This pattern of songlines would not be viewed as from above, in the way we might imagine them, but from a horizontal perspective, lines that proceeded out from the self. This perspective is essential in a system where 'objective' realities such as trees, rocks and mountains are invested with emotional and spiritual power. Such a system cannot be portrayed in a way that abstracts the hearer from the system, as is done with an orthographic map for the sake of objectivity. The songlines, and the Maori oral maps, are designed to include the audience. 'This line starts from here, where we are.'

A remarkable method of changing "amorphous space into articulated geography" (Tuan, 1977: 83) is found amongst indigenous Pacific islanders. On Puluwat, an island in the Carolines, themselves part of Micronesia, the word 'ocean' means not a vast body of water but an "assemblage of seaways which lie between the various islands" (Gladwin, 1970: 34). Mastery in navigation through this (to western eyes) dangerous and featureless seascape is achieved through learning a sequence of names of islands, reefs and the stars which guide the navigator to them - not just from the perspective of one island, but from all of the islands to which the navigator might conceivably wish or need to go. "What the student eventually acquires is not a long litany of names but the detailed pattern of stars, islands and reefs" (Tuan, 1977: 82). This detailed pattern is tied together by a system called *etak*, a "special logical construction or cognitive map based on the conception of a moving island" (Gladwin, 1970: 181). The journey of a Puluwat navigator largely takes place in a boat seemingly fixed in a position determined by the immovable equatorial stars and the sun. Everything else appears to flow past to the left or right, just as scenery appears to march backwards as seen from the windows of a car. The closer scenery (islands and reefs) moves faster than that which is on the horizon. Indeed, the islands need not be visible, and are most often hidden. For each journey there is a sequence of islands, and stars to judge their position, organised so that at least one reference island is available (Figure 7.20). Thus the journey is divided into segments, enabling the navigator to use dead reckoning to work out how far they have travelled. What is most important for this discussion is that the geography is relative to the position of the navigator, who is fixed. For the Puluwatan, self is at the centre of the cognitive map.

These are three Pacific examples of how space can be structured in a non-Euclidean but intensely meaningful and useful fashion. In each case the technique depends on a procedure, and in each case the system is designed to allow the user to place him or herself in the system.

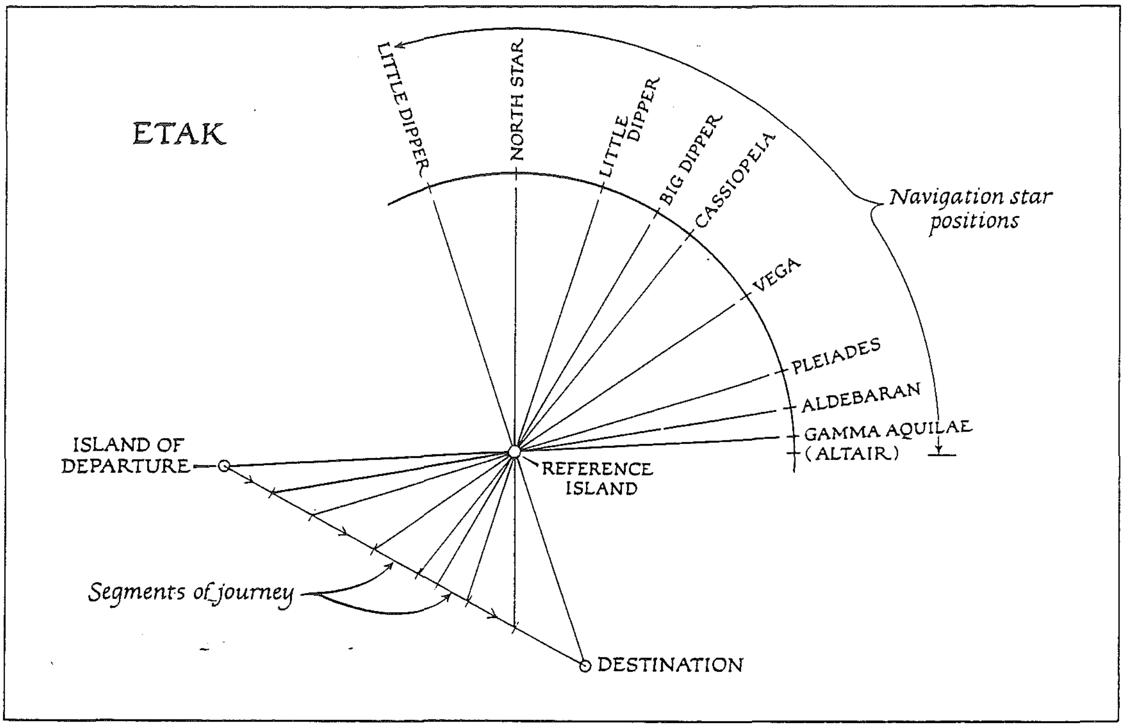


Figure 7.20. Etak. Source: Gladwin, 1980.

Summary: Procedural and Euclidean Space

While Keates advises that maps should be "an orthogonal projection of the Earth's three-dimensional surface on to a plane" (Keates, 1989: 3), the present author argues that the vertical (planimetric) perspective forces the user to view from above and outside the depicted space, thereby abstracting that individual from that space, eliminating the time (and thus the historical) dimension and whatever feelings and values are attached to that space. He advances the notion that, if these are qualities that in certain circumstances ought to be preserved, a perspective capturing the time element should be employed, such as the procedural perspectives introduced in this discussion. In particular, if the scale and subject of the communication is such to include elements of human experience - especially if it is individual experience - procedural space would be a preferred alternative to Euclidean space. It is hard to imagine an improvement on a planimetric map for portraying purely physical topographical relationships, particularly if they are of a global or national scale. Again, however, there are viable alternatives to Euclidean space if the scale is small and the subject is human, such as the cartogram.

Simply stated, maps as conceived by cartographic theorists are too inflexible. The alienation of human sensibilities caused by unthinking use of Euclidean spatial constructs can be halted by the judicious use of alternative perspectives. Employing such alternative reconstitutions is a first step towards putting self back on the map.

Examples of Alternative Reconstitutions

The present author has produced three alternative reconstitutions and tested them in a number of situations. These three maps are examined in this section of the chapter. They are, in order, a logarithmic transformation, a schematic map of personal safety and a schematic map of bus routes of Christchurch city.

Logarithmic Transformation

Figure 7.21 is a logarithmic transformation centred on the University of Waikato's student Halls of Residence. The technical aspects of its construction are not directly relevant to the discussion except to say that the very centre of the transformation is obviously not on the same scale as is the rest, given that there is no logarithm of zero. Following Chapman *et al* (1985), an arithmetic unit is interpolated between the minimum log value and zero.

The transformation was created by the author as a base for students to display personal information as part of a first-year geography laboratory exercise. In the week previous to the exercise the students were asked to record their movements and the time spent at the different places they went to over a period of seven days. During the laboratory they were asked to aggregate these data and portray them on both a standard map of Hamilton and the logarithmic transformation. In order to assess whether anyone was having trouble reading the logarithmic map, students were instructed to locate and label Taranaki and the Coromandel peninsula on this map. 2% of students needed formal assistance with this, indicating that most students successfully interpreted a potentially disorienting map. This was considered remarkable both by the author and those staff and senior students assisting with the exercise, particularly when it is considered that it was the first laboratory exercise for the year and the students had not been exposed to this transformation previously. On completion of their maps, students were encouraged to exchange them with others. Each student was able to make inferences about the lifestyle of the map's artist from the reconstitution they were presented with.

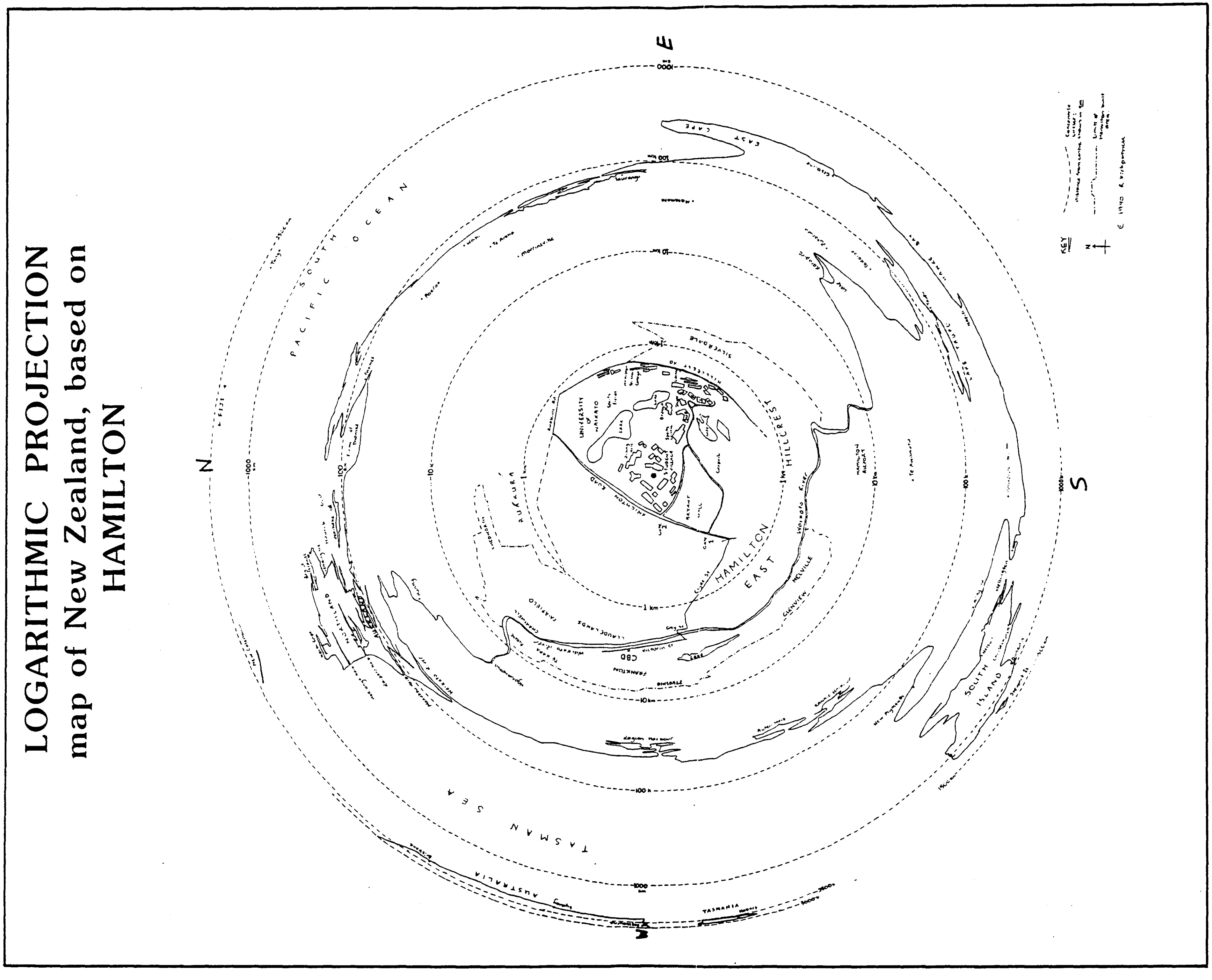


Figure 7.21. Logarithmic projection of New Zealand, based on the Waikato University Halls of Residence, Hamilton.

A crucial ingredient of this exercise was that students were doing their own mapping. An alternative exercise could have been presented where students were required to distinguish between already-drawn maps of different projections. While making the exercise easier logistically, this would have removed the fundamental assumption that *students would favour the logarithmic transformation when mapping their own data in their own fashion*. In this sense, the exercise was an attempt to blur the separation of generator, maker and user in the map making process.

An example of a completed logarithmic transformation map of where one student's time was spent is presented as Figure 7.22. The scale and extent of the map enables the student to place all of his activities on the map in a way that clearly distinguishes their location. His standard map did not afford him this opportunity, forcing him to aggregate all of his university time into one circle and to put his time in Auckland into an inset. The title he gave his logarithmic transformation reveals how much he was able to put of himself into the work: "My one-eyed perspective" indicates that he knows that this map is his personal view and no objective representation of spatial relations. The subject of the map was one which was engrossing to the students, who were able to put themselves on the map.

The exercise was repeated, with minor variations, at the University of Canterbury. The base map used was again drawn by the present author (Figure 7.23). As in the Waikato exercise, first-year students were asked to collect time and location data over the previous week and record them on a map. One such map is shown in Figure 7.24. In this exercise students could choose whether to portray their data on a standard map or the logarithmic projection, and were asked to record the reasons why they chose one projection over the other for the task. This enabled the author to draw some simple conclusions about the relative merits of the two projections for mapping this kind of data.

Of 171 maps drawn, 101 were logarithmic transformations and 70 were standard planimetric maps. The fact that 59% of students used the logarithmic transformation means little on its own until explained by the reasons given for their choice. 144 of the 171 students chose their particular projection because it was the best fit with their data: those who wished to record a lot of activity close to the University chose the logarithmic transformation, while those whose activities were centred some distance away from the University tended to use the planimetric map. This indicates that many more would have chosen this projection had students been able to centre their logarithmic transformation on their own centre of interest.

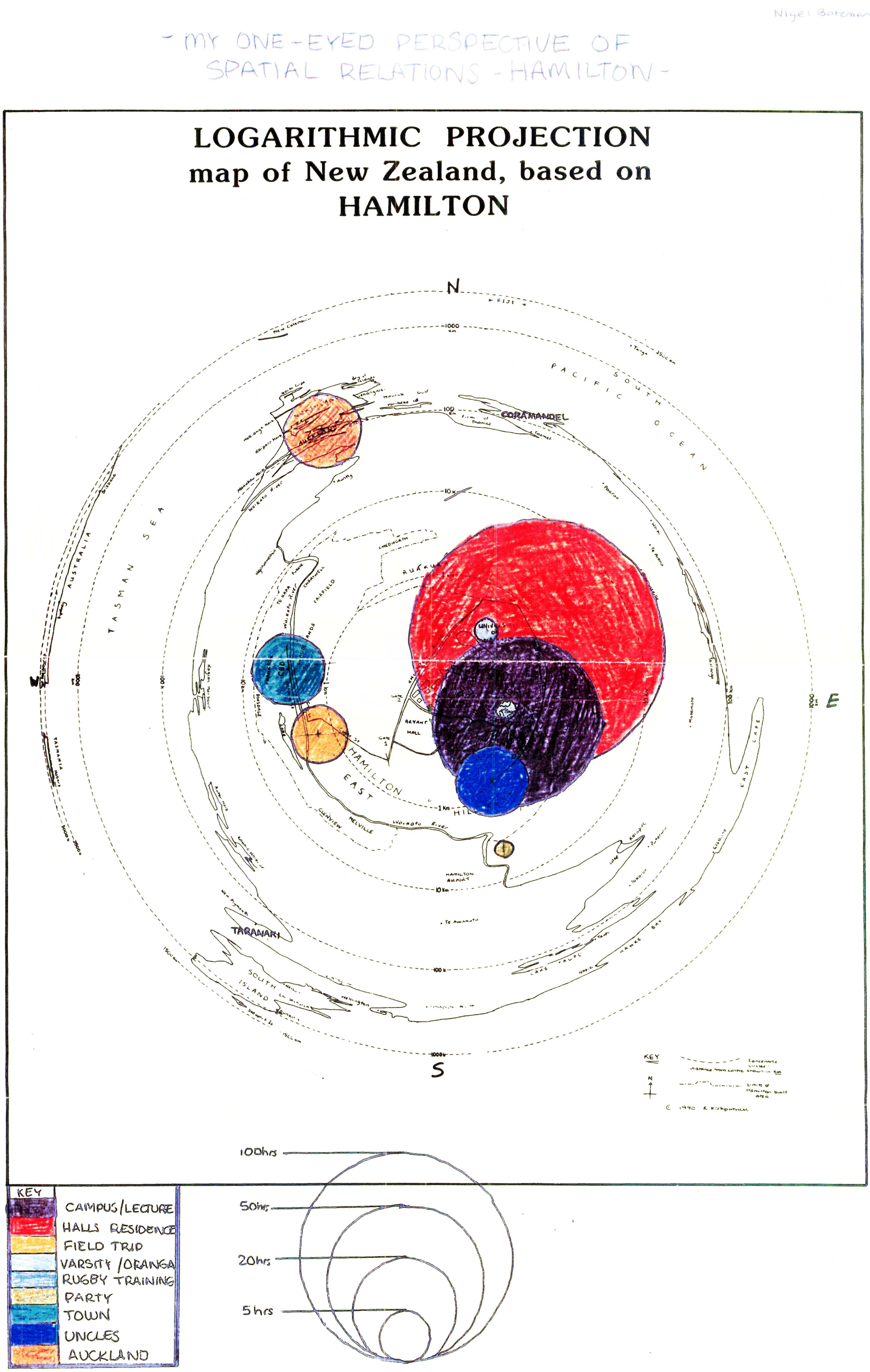


Figure 7.22. Nigel Bateman's logarithmic map.

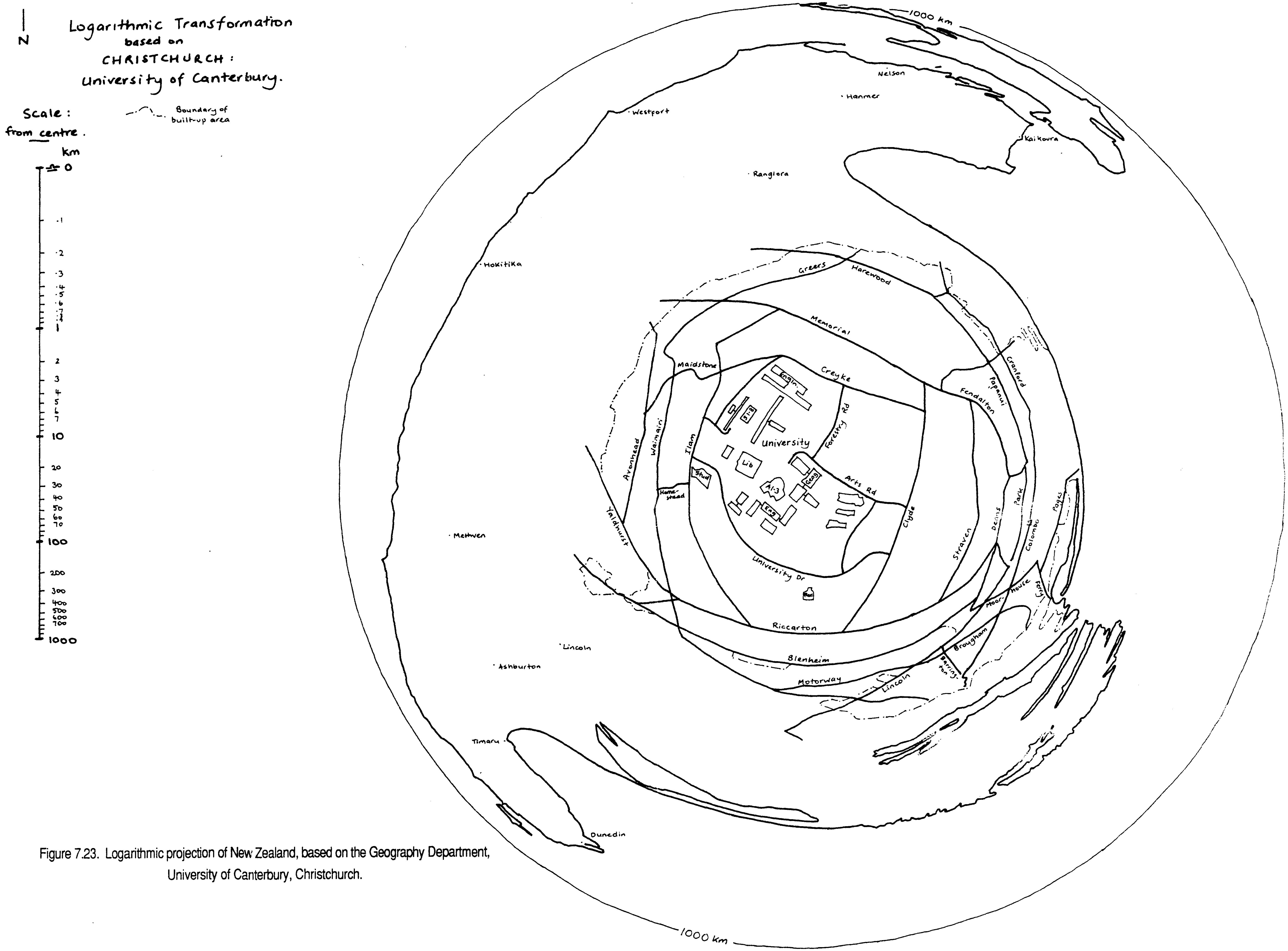


Figure 7.23. Logarithmic projection of New Zealand, based on the Geography Department, University of Canterbury, Christchurch.

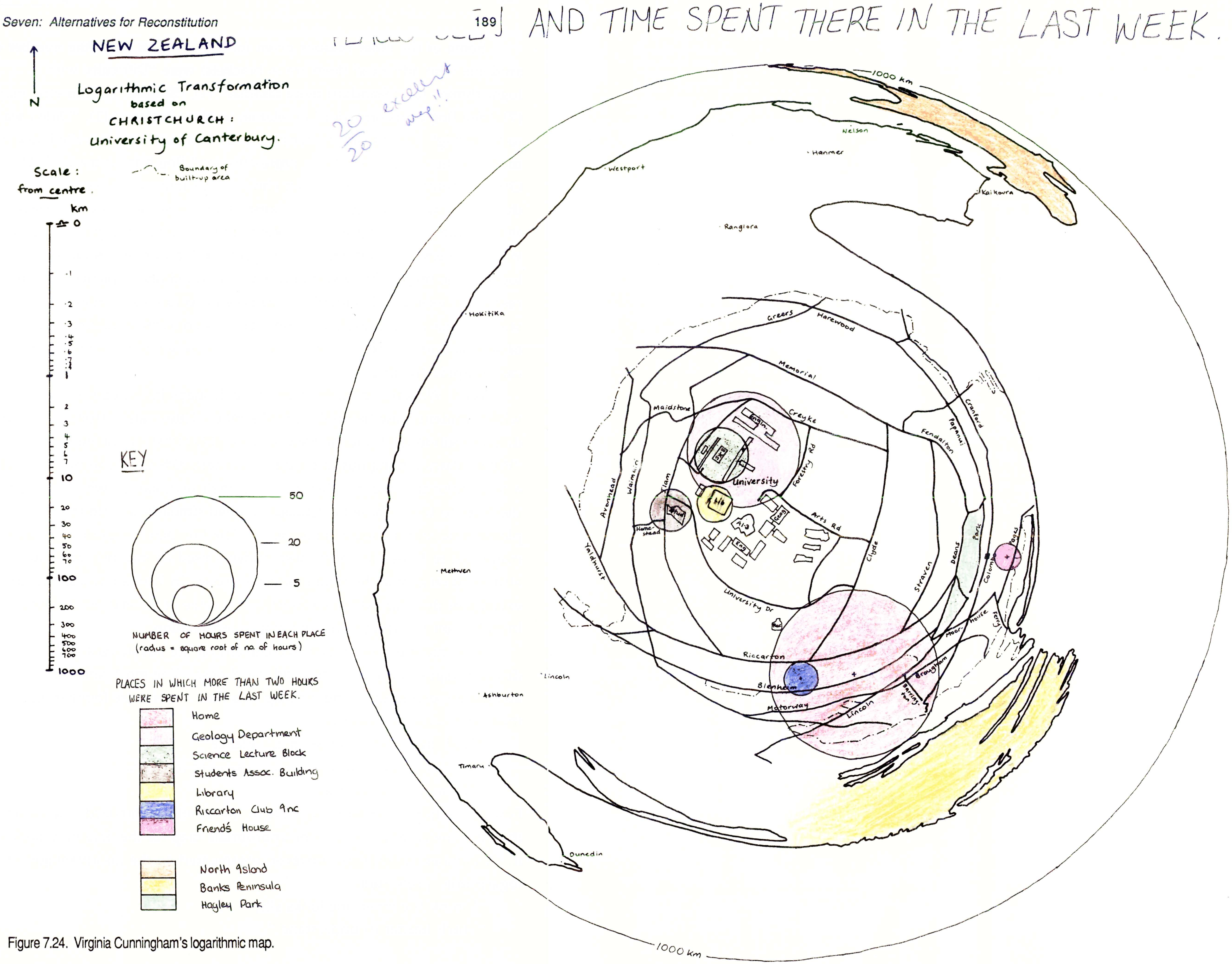


Figure 7.24. Virginia Cunningham's logarithmic map.

Some of the other reasons given for the choice of map (the number of students who advanced them are in brackets) were "Difficulty with logarithmic" (5), "Standard more familiar" (1), "Simple" [planimetric map] (7), "See [log transformation] in relation to New Zealand" (1), "Didn't want to be boring" [log transformation] (1), and "Distance/time travelled decays as move further away, so a better representation" [log transformation] (1). Others offered no reason for their choice. This indicates a degree of discomfort with the logarithmic transformation that was not uncovered by the expedient of testing whether people could use it correctly. In fact, as at Waikato, very few students had any problem locating places on the logarithmic map. This discomfort was confirmed and explained during the rest of the exercise. It should also be noted that to a small number of students the logarithmic transformation was an exciting challenge, a source of stimulation the like of which they had not received from the rest of their cartographic training.

As at Waikato, the titles given to their maps indicated the level to which students saw themselves in the map. Titles varied from "Time-space data of individual 'J' for the week ending 12/7/1990" to the informal "Where Patrick hung out this week." Overall, 33% used a formal title, 26% a more informal title (i.e. they included their own name), while 41% gave the map no title. These percentages applied similarly to both the planimetric and the logarithmic maps. The low percentage of informality as compared to Waikato where most students used an informal title can be attributed largely to the timing of the exercise. In Waikato it was the first exercise of the year, while at Canterbury it came at the end of a traditional introduction to cartography and map interpretation.

The students were asked to comment on the advantages and disadvantages of the map they did *not* choose. The most common advantage seen in the standard map was that it was more familiar and therefore easier to interpret:

"Trad. map easier to take in at a glance."

"More accurate and undistorted, easier to recognise."

"The map I am used to."

Few students had anything negative to say about the standard map, except that in some cases it was not the appropriate map for the data presented on it. A number of students, however, commented on the disadvantages of the logarithmic projection:

"I think the other one looks silly."

"Much harder to understand."

"Unfamiliar - so straight away you don't want to use an unfamiliar map."

The advantages of the logarithmic projection were also recorded:

"Much better visual representation."

"Its exaggeration was more suitable to display the data."

"Felt like being adventurous."

"I specifically liked the way the logarithmic map illustrates how parts of the University and Christchurch were related to, or at a distance from, the larger South Island."

Another writer suggested a compromise:

"I think both the logarithmic map and the 1:50,000 Christchurch could be combined on one map with city area and a blow up of the University Campus."

It appears from these comments that many students felt more comfortable with the familiar standard planimetric map while also recognising that the logarithmic transformation provided a better base to display their data. After taking part in a course that dealt almost exclusively with the interpretation of planimetric maps, students were not representative of how people of their age and education level might otherwise respond to this exercise. In spite of this, only 41% actually chose the planimetric map to display their personal data.

It is legitimate to label this logarithmic transformation a procedural one, as it is centred on an area of common everyday experience (the University Campus), and the perspective is neither planimetric nor horizontal, but a compromise between the two. The enlargement of space around the centre allowed locations to be shown that are not normally discernible on a map that includes all of New Zealand, thus enabling students to put more of themselves and their everyday lives on the map. It enabled students to communicate to others a view of their own worlds.

Using a logarithmic base for the display of short-distance population movement in Guadalcanal, in the Solomon Islands, Chapman *et al* (1985) produced results that "appear to fit the people's worldview remarkably well" (p 16). The writers comment that their exercise "has demonstrated the capacity of cartography to depict and to summarise cross-cultural realities about location, place, territory, and worldview" (Chapman *et al*, 1985: 19). They conclude by advocating a greater concern for creating visual models of patterns in human behaviour by cartographers and geographers working together.

The laboratory exercise was carefully chosen to reflect a combination of space and time. Students were required to locate time in space, and favoured a procedural transformation to do it. The results of this exercise, while suggesting that traditional cartographic education is a major barrier to acceptance of alternative formulations, add weight to Szego's contention that space needs recombining with time in order to be invested with meaning (Szego, 1987). Yet this is one area in which maps have traditionally been considered deficient. Davies (1985) writes:

> "There are things they cannot do, others they do badly... they portray the world in essentially static fashion, whereas the reality is essentially dynamic... the fourth dimension of time cannot be generally and effectively represented" (Davies, 1985: 4).

In this exercise students have grappled and largely come to terms with an unfamiliar transformation to portray the relationships between their spaces and their times. It appears that this sort of transformation might be useful in representing the fourth dimension. Maps like this could be used in a number of situations. For example, the one base map could show the action-space of a typical city inhabitant today as compared with those gained from the diary of a pioneer settler who lived in the same area. This sort of perspective might well achieve what Szego suggested it would: the mediation of history and geography.

Schematic 'Campus Safety' Map

One evening early in 1988 a woman student was attacked on her way home from lectures at the University of Canterbury. The most serious in a lengthening list of such incidents, this attack prompted much concern among students. At the same time this present author had conducted a survey of 102 first-year Geography students to find out where on campus they felt most unsafe. This survey was part of preparation for the present thesis, and sought to examine ways of graphically portraying subjects that are not normally mapped, such as feelings and emotions. Examination revealed that car parks are the places where students felt most unsafe, particularly those which are closest to the periphery of the campus. The map also shows that the routes home to the Halls of Residence are considered unsafe, being constricted, often poorly-lit corridors.

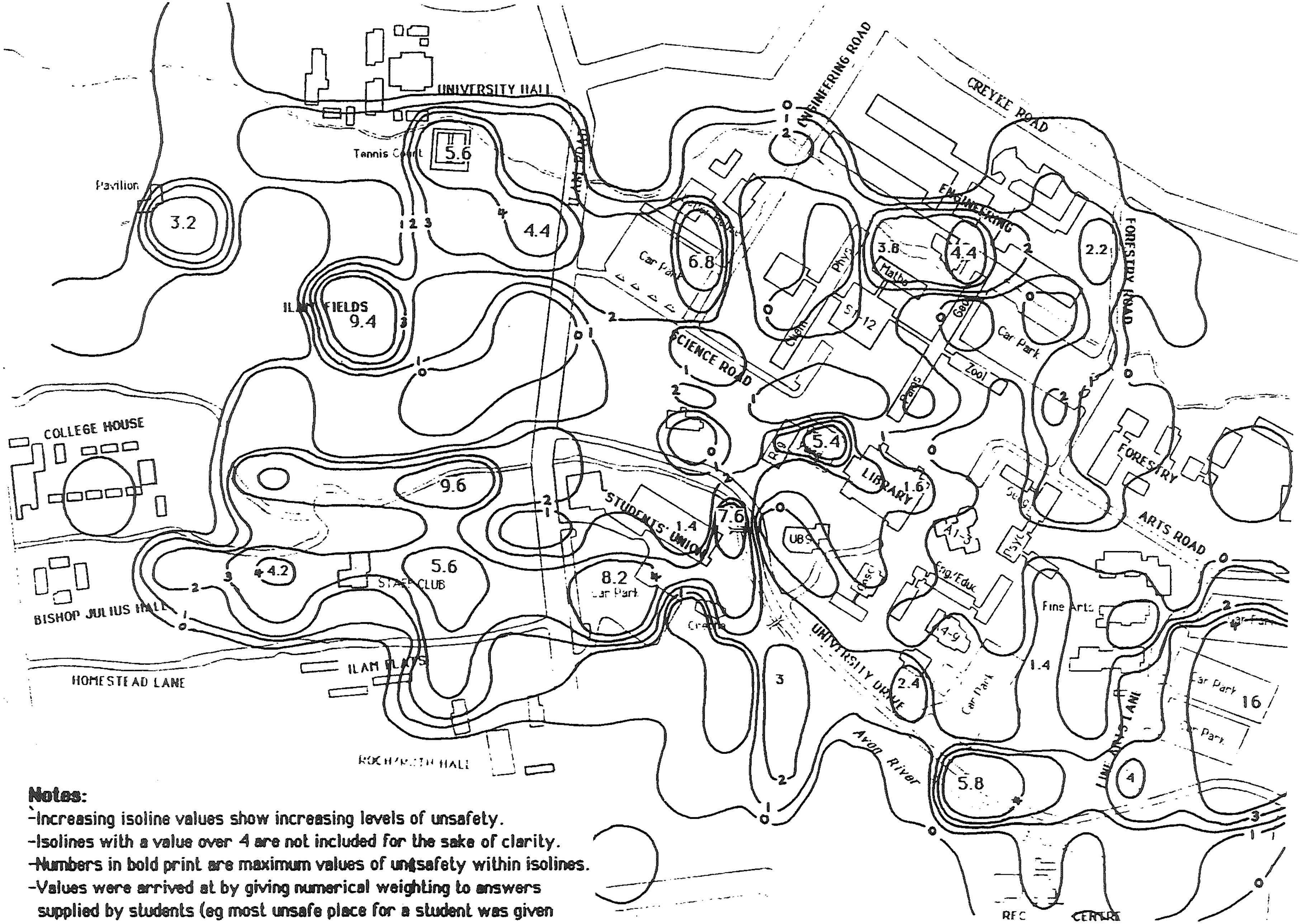
In the light of the debate provoked by the attack, it seemed sensible to present the results to the students and to the University administrators.

The factors uncovered by the survey were of potential importance to students, and the the editors of Canta, the student newspaper, requested that they be presented to the student body in one of their issues. How could one present such subjective feelings as 'unease' and 'fear' in a way which would not see them being dismissed as 'unscientific', yet in a manner easily understood by those who needed them? The solution was to use a map.

The first map tried is shown in Figure 7.25. The areas of relative fear are shown by contours, with higher numbers representing greater levels of unease. The data were placed on a planimetric map base, so in terms of the alternatives for reconstitution this map is Ic/Tf. The major problem with the map is its complexity, with the many buildings obscuring the main message. It has a spurious air of accuracy, demanding detailed interpretation which encourages users to read off an unease value which has little meaning, given that the sample was biased (being first-year geography students) and the contours were inferred. The planimetric map does not represent the campus as the geography students saw it.

Figure 7.26. shows the final result as printed in Canta. This map looks less scientific, with buildings not shown true-to-scale. Another section of the student survey exercise involved their drawing schematic maps of the campus as they experienced it, the results of which were able to be aggregated to produce the map base. The use of this schematic base presents a better picture of how geography students see the campus, and so is more faithful to the survey results than a traditional map might have been. It is a map that is not supposed to be the subject of detailed interpretation, a fact that is emphasised in the accompanying article. The map is said to summarise patterns, not to present detailed results. Because it appears in a student newspaper, its impact has to be immediate and it should not require close examination, which rules out the use of a logarithmic transformation. The colour helps to enhance the impact of the map, grabbing the readers attention in a manner not achieved by the first iteration. The crucial factor is that subjective spatial relationships have been shown in an easily understandable manner, without distorting the results of the survey.

The outcome of the debate saw a commitment to improvement of campus lighting, with work beginning in late 1988. The map and accompanying article appeared in the next years issue (1989) of the student orientation manual (received by all students enrolling at university as an introduction to the campus), the only map to do so.



Notes:

- Increasing isoline values show increasing levels of unsafety.
- Isolines with a value over 4 are not included for the sake of clarity.
- Numbers in bold print are maximum values of unsafety within isolines.
- Values were arrived at by giving numerical weighting to answers supplied by students (eg most unsafe place for a student was given a value of 1, fifth most unsafe place was given a value of 0.2, etc. and all values for all students were totalled and mapped as isolines).

Figure 7.25. University of Canterbury first-year geography students' fear map of campus, first draft.

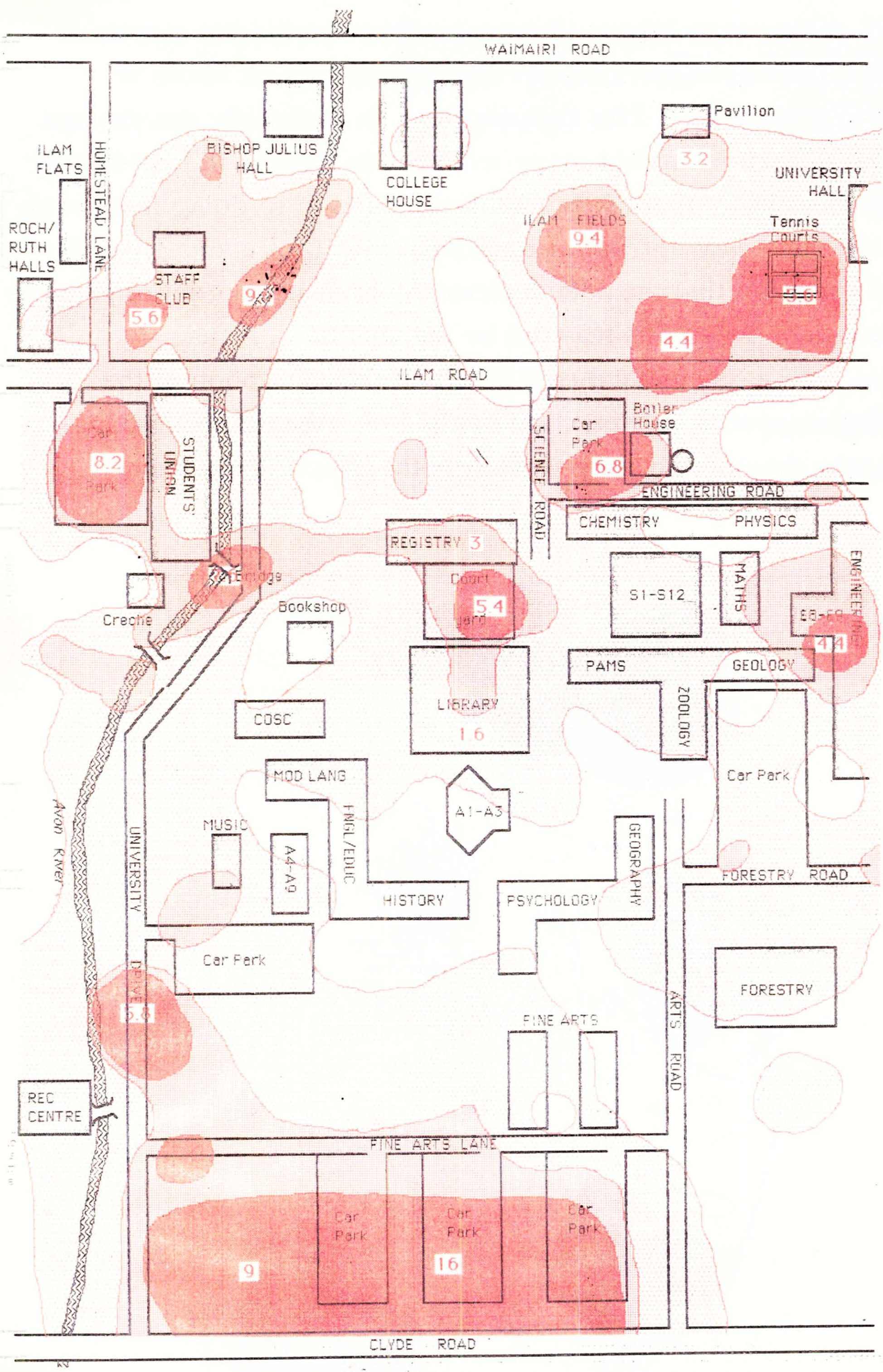


Figure 7.26. University of Canterbury first-year geography students' fear map of campus, as published in Canta (Kirkpatrick, 1989).

The vast majority of 'thematic' maps, including those with innovative subjects, tend to be unthinkingly reproduced on traditional planimetric map bases (Figure 7.27). In the case of the campus safety map, an adherence to this tradition would have been unfaithful to the data. The choice of a schematic map base may help to illuminate otherwise hidden aspects of people's lives, their opinions, feelings and perspectives on issues of importance to geographers. Not knowing how to adequately analyse and represent the subjective has led many scientists to indulge in 'cost-benefit' analysis which seeks to quantify human feeling and in so doing reduces its worth. In the same way, the use of traditional map projections gives the reader the impression that the data depicted is of the same order of value as topographical data, when this may not be the intention. A map reconstituted with a schematic metric based on the conception of the subjects being mapped is one practical method of presenting subjective factors in a way that more closely represents the lives of those being mapped.

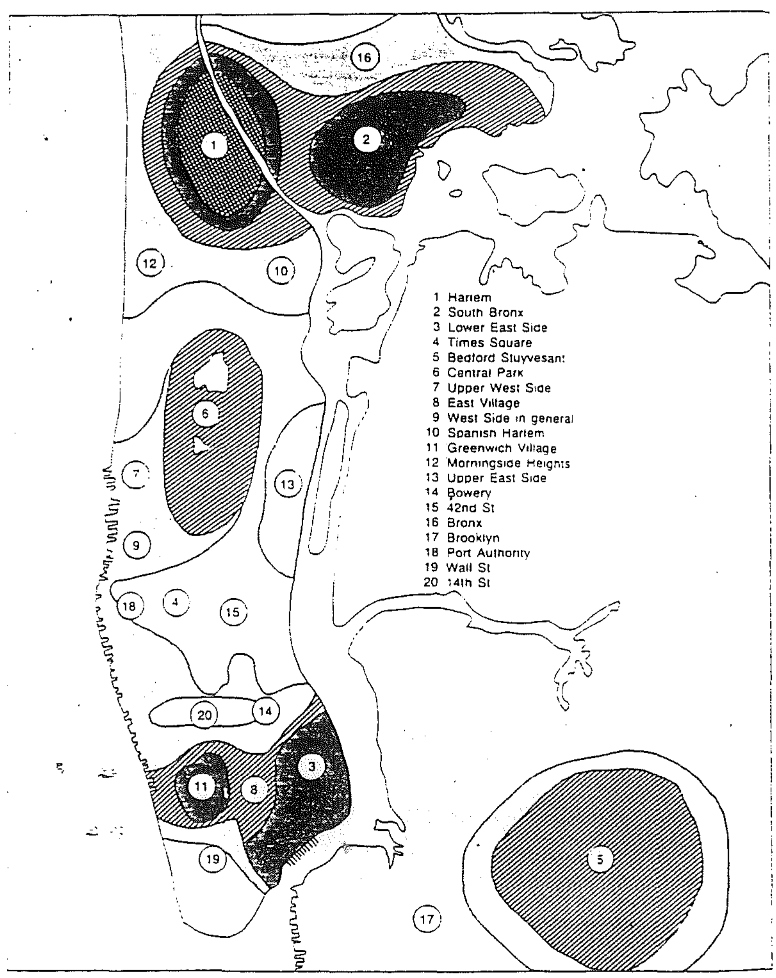


Figure 7.27. The topography of fear in New York, 1977. Source: Knox, 1987: 160.

Schematic 'Bus Routes' Map

The third example is an attempt to construct a map that makes sense of the complex bus routes of Christchurch city (Figure 7.28). The idea behind the schematic map base is not new, suggested by the London Underground Map and copied by hundreds of other cities. One new feature is incorporated in this map: the metric is not entirely schematic, with the first six sections (zones of similar fare costs) drawn an equal distance apart. In this sense the map is a cost-space distortion of the planimetric map. The unique problem presented by Christchurch public bus routes in 1989 was that each route either originated or passed through the Square, the centre of Christchurch, and that many of the routes were combined so that patrons could travel from one side of the city to the other without changing buses. As with the London Underground map, therefore, the centre of this map is greatly enlarged to make it easier for bus users to discover where in the Square their bus leaves from. The colours were then chosen to make it easier for people to discern which routes interconnected. The one schematic map contains the information at present found in three planimetric maps produced by the Christchurch Transport Board.

A computerised version of the map, which incorporated two small design changes, was produced in 1990 to accompany a computer-based G.I.S. of Christchurch. First, names of prominent Christchurch attractions replaced the names of the section stops, these proving to be of greater interest to the potential user. Secondly, the map was computer-animated so that a user who selected any destination saw a small icon of a bus, complete with engine sound, move from the correct departure point in the Square along the route to the correct stop.

Twenty-seven members of the public tried this computer map when it was based in the Canterbury Museum, located in central Christchurch, during two weeks of August 1990. Although the test was small, no users were solicited and all came to the map with genuine problems to be solved, such as "where do I catch the Jameson Avenue bus?" and "bus routes are normally complex - what of yours?" Of the twenty-seven who used the map, twelve had no previous computer experience. This proved to be no handicap. In all cases the feedback returned was positive, with users entering comments on the machine such as "A good idea" and "Should be in the Square". Chapter Nine explores further the notion that testing a map in its real-world setting is the most reliable test possible.

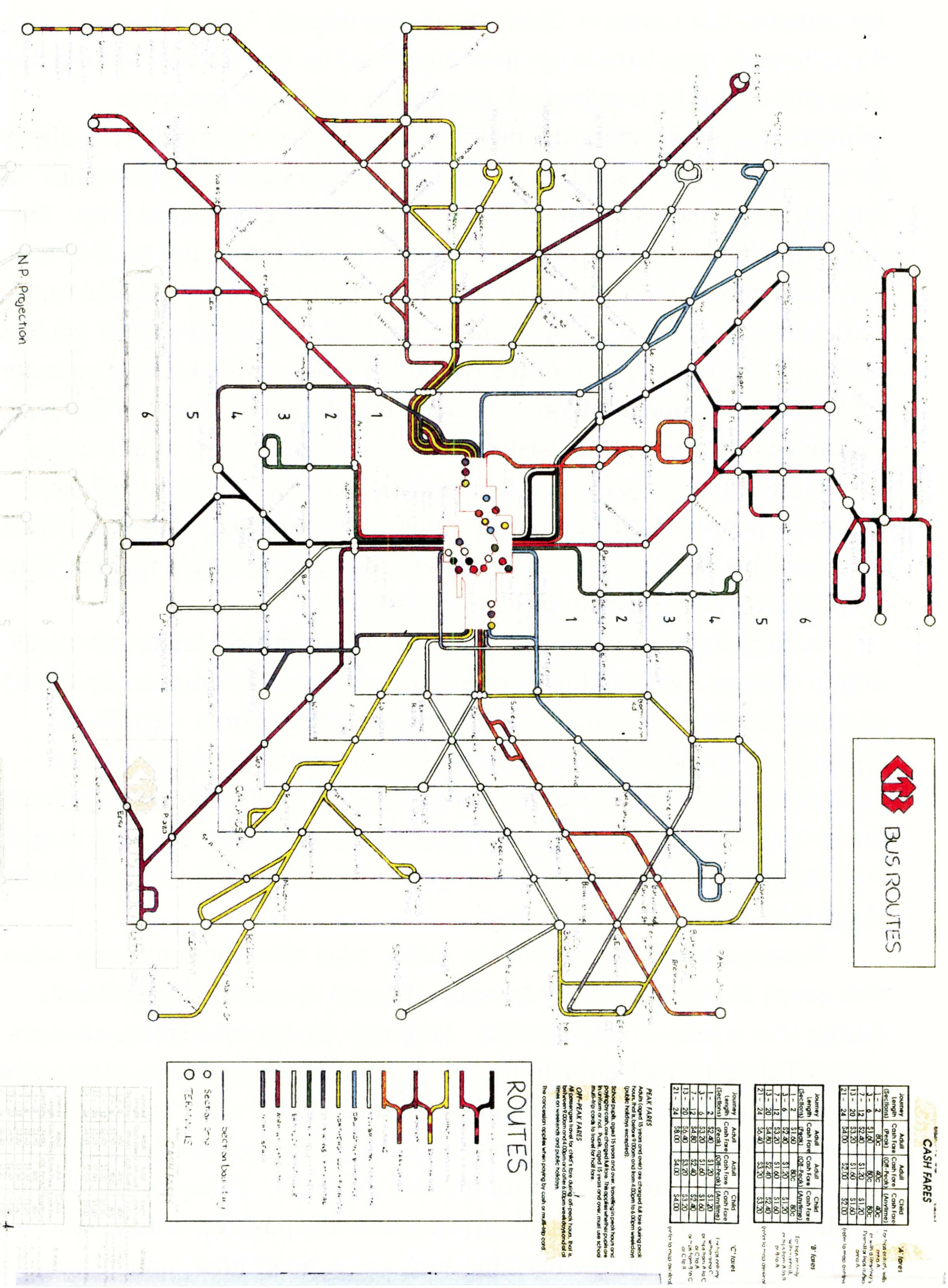


Figure 7.28. Schematic map of Christchurch bus routes.

The author contacted Christchurch Transport, as they are now known, who have shown an interest in using the Bus Routes map. They have suggested the idea of commissioning the author to produce a revised version of the map which takes into account the changes which will result from deregulation of the bus service in 1991, as a device for promoting the new service. They wish it to feature on the major bus shelters, in the buses themselves, on the bus route leaflets and on a promotional brochure. The map has therefore proven a success in its initial public outing, capturing favourable comments from the public who actually had to use it to solve real-world problems, and attracting the interest of the providers of the service.

Summary of Alternative Reconstitutions

The reason each of the three graphics discussed above was produced was to communicate information of concern or interest to people. In many cases the users overcame their reluctance to the use of an alternative reconstitution, some seeing the alternative as a distinct advantage. A number of potential users, however, were dissuaded from using the logarithmic projection. This map proved a little more difficult to interpret than the planimetric map, but in spite of its unfamiliarity was judged superior in its ability to represent students' personal time-space information. The second and third examples were designed to communicate information in the most efficient manner possible, with the schematic Campus safety map designed to attract attention and transmit an impression in a manner not dissimilar to the advertising maps discussed in Chapter Six. This was done without sacrificing fidelity to the original survey upon which the map was based. The Bus routes map incorporates information previously displayed rather badly on three separate maps. Each has proved satisfactory in limited testing: it remains to subject an alternative reconstitution to a more extensive test. Such a test is the subject of Chapter Nine.

Conclusion

While they are the most prevalent in western society and are regarded by some as the only 'real' maps, orthographic maps based on a Euclidean-derived vertical, planimetric view of the world may not always be the best reconstitution of spatial data. This applies especially to that data which is localised in space and personal in content. The use of an orthographic projection with arbitrary symbology is often too great a degree of abstraction from reality to interpret for many people, decreasing the relevance of these maps. Because these maps are ubiquitous in the depiction of data the state considers important, many people are effectively disenfranchised from the appropriation of resources.

Alternative reconstitutions exist in the form of mathematical distortions of Euclidean space, schematic non-Euclidean representations and the procedural space favoured as practical by non-literate cultures. The alternatives offered in this chapter have in common the fact that, to some extent, they allow a recombining of time with space. This is done by perspectives and manipulations which incorporate elements of historical and geographical views in what this thesis calls the oblique procedural perspective. The maps allow users to put themselves on the map rather than having to view the map from above and outside it. In the case of maps such as the Puluwatan etak and the logarithmic transformation, self is placed at the centre of the map. In common with the way people think, the self is the one unchanging fact in a mutable world.

This chapter has not provided a set of alternative cartographic rules, but was written as a springboard for further original reconstitutions and application of them to traditional and innovative subject matter. Thought about such matters is to be encouraged particularly if, as is suggested in the next chapter, the deterministic role of the map generator in subject selection can be bypassed, an eventuality which would greatly enlarge the number of subjects that could be mapped.

Chapter Eight

Alternatives for Deconstitution

Introduction

The major determinant of the types of maps society uses is neither demand nor the desire of cartographers but the wishes of map generators, themselves governed and constrained by the economic, social and political shape of society. These people and the institutions they represent help determine the content of maps, influencing the generally expensive and time-consuming process of deconstitution. Alternative reconstitutions of given data may help users understand that data more easily, but such reconstitution represents only one possibility for making maps more relevant to people. The other possibility, more necessary and seemingly more difficult, is to somehow promote user-driven map subject selection. Such a possibility is central to this chapter, written to address the problems raised by statement 2 (found at the end of Chapter Six).

This chapter is divided into three parts. Firstly some alternative deconstitutions are examined, maps which are attempts by others to tell a different story than traditional maps have told. These alternatives are reactions to the unsatisfactory form and content of maps (in the view of the participants). The discussion identifies three clear limitations of these deconstitutions. These may be overcome by the use of interactive mapping systems, the subject of the second section. The potential and problems of Geographic Information Systems (G.I.S.) are revisited with a view to outlining a possible system in which users generate their own data. This notional system is introduced in the third section of the chapter, leading into a discussion of guidelines that may help the development of such notions into a workable reality.

The difficulty of isolating deconstitutive acts must be noted. Examples given in this chapter are as much reconstitutions as deconstitutions, having been drawn as well as conceived. While this chapter is specifically concerned with the *conception* of the map (the message and the data selected to represent that message), this cannot be examined separately from the manner in which those data are displayed.

Telling a different story - some alternative deconstitutions

There have been a few individuals and community groups who have attempted to collect their own data and map it in response to perceived inadequacies in traditional maps. Others, such as artists, have manipulated the form and content of maps to point out these inadequacies. Some have simply despaired of maps ever reflecting the realities they know. Each response is a reaction to the hegemony of orthographic maps and the exploitation they represent.

E.F. Schumacher recounts a visit to Leningrad in which he uses a map which does not show churches. He writes: "It then occurred to me that this was not the first time I had been given a map that failed to show many of the things I could see right in front of my eyes" (Schumacher, 1977: 9). The maps of life and knowledge that Schumacher seeks would not omit that which could not be proved empirically to exist; rather, his maps would prominently display areas of doubt and debate as a challenge to the living. "The maps produced by modern materialistic scientism leave all the questions that really matter unanswered" (Schumacher, 1977: 13). He has discovered that literal maps reflect the thinking behind philosophical maps, which reflect the scientific and social orthodoxy of the time. Schumacher wants maps that ask questions, not supply answers.

Ruth Watson has taken this discontent with what maps show a stage further. Her work World Map (Figure 8.1) derives from a map drawn by Johannes Schoner, a Nuremberg cartographer and globe-maker of the sixteenth century (Figure 8.2). Schoner's World Map: gores for the Southern Hemisphere, a "rough azimuthal projection" (Curnow, 1989: 23), appears accurate but countenances the mythical Terra Australis. This appearance of accuracy is enhanced by the depiction of a measuring instrument on the map, as though Schoner knew the bounds of the great southern continent. "European man had set out to conquer the world, and he enjoyed having himself portrayed with all the little machines that gave him the power to do it" (Descargues, 1977: 10). Terra Australis is not displayed as an area of doubt or debate, but as fact. His map is a representation of the glory of exploration, of the expansion of man's knowledge and power.

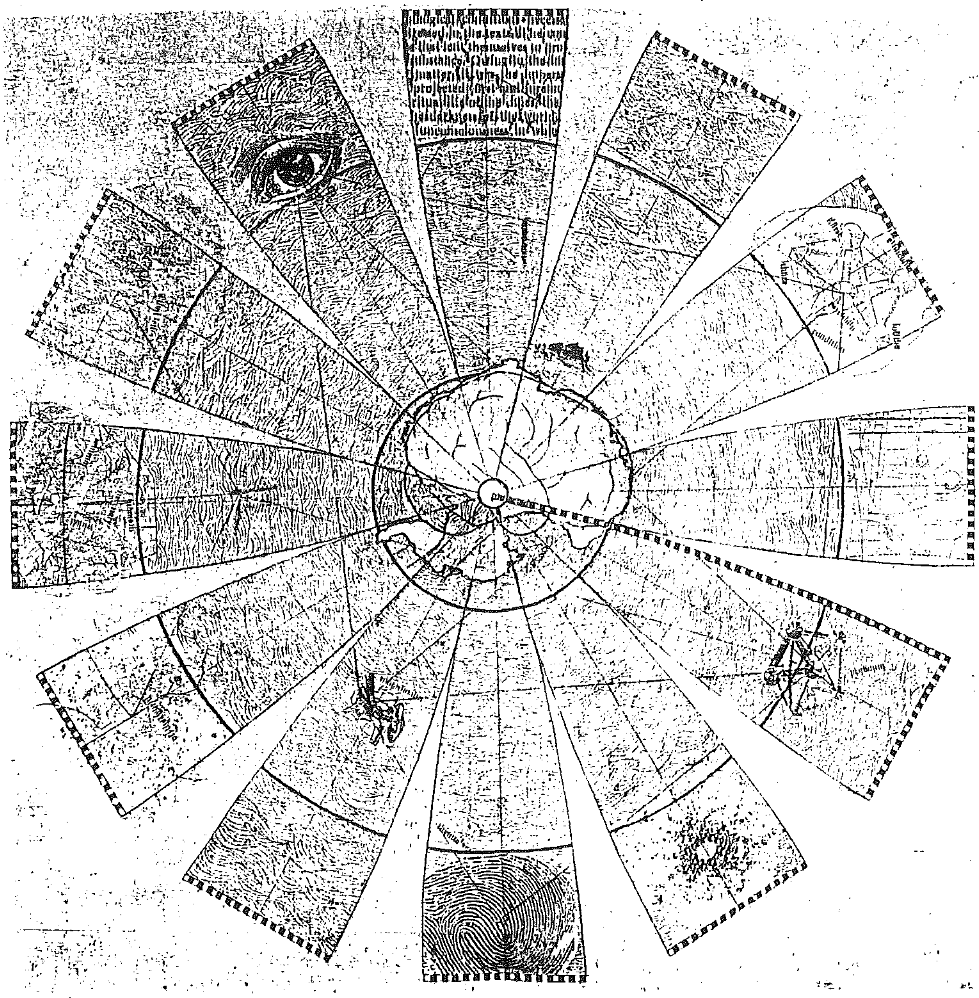


Figure 8.1. Ruth Watson, World Map 1987. Source: Curnow, 1989.

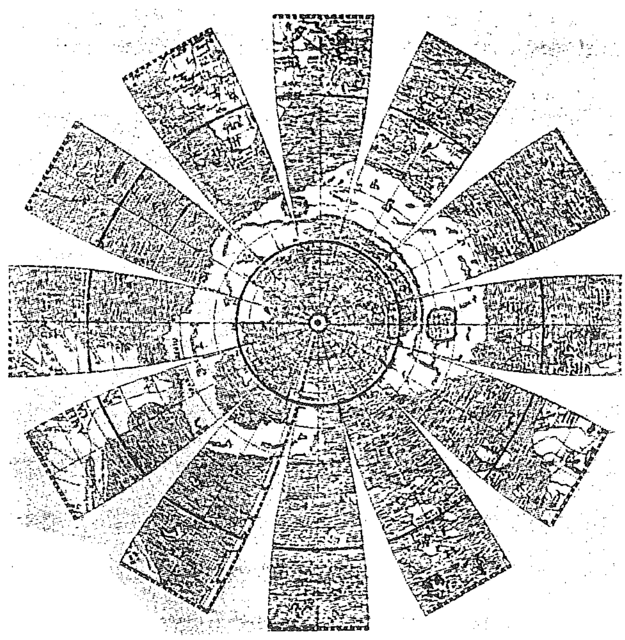


Figure 8.2. Johannes Schoner, World Map: gores for the Southern Hemisphere 1515.
Source: Curnow, 1989.

Watson uses the same reconstitutive style to present a message quite different to that of Schoner. "Watson takes great trouble to simulate the appearance of the original" (Curnow, 1989: 23). Her map has a cartouche, a measuring instrument, similar-looking text and colours. It is, however, a map of the Self, a personal mythology rather than a world myth. She has chosen to counter Schoner's orthographic expansionist thrust with a map of self-discovery, in which the focus is on the unfamiliar territory within as represented by the brain/foetus shape at the map's centre. The data on her map have been deconstituted from within herself.

Her world is more real than Schoner's, for it is shaped like Antarctica, yet is inward looking - note the eye gazing towards the centre of the map . This is reflected by her portrayal of a speculum as her measuring instrument, a sign of gender and of "the institutionalised gaze" (Curnow, 1989: 23). She points out the fallacy of Schoner's map, suggesting that it looks in the wrong direction, for real discovery is to be made introspectively. Above all, the sixteenth century vision has no place for the Self. Watson's fingerprint on this work is an emphatic statement putting Self on the map.

Richard Wurman, a Philadelphia architect, has produced maps that seek "to allow people to gain a sense of participation in the city and so take an interest in improving it" (Time, October 16, 1972: 60). Starting with maps of the city's buildings and infrastructure, his book Man-Made Philadelphia "reminds the reader that there is a lot of ordinary, gritty landscape between... touristic highlights, and that these gaps - not the landmarks alone - give the city its texture, content and life" (Time, October 16, 1972: 59-60). These procedural maps show the old bridges, the best ice-cream stand in the city and even an automobile crusher. The run-down dockyards, the slums full of graffiti, the traffic jams all feature. His designs were produced with the goal of making the city more understandable to the average resident, "thus more changeable and ultimately more livable" (Time, October 16, 1972: 60).

His vision reflects that of a short-lived movement that took place in eastern North American cities in the late 1960's and early 1970's. Spontaneously, in a number of these older, crowded and polluted cities, local groups, community committees, professional designers and geographers began to challenge the institutional way of looking at urban space. Maps were produced by these groups in response to urban renewal and redevelopment projects which threatened a lifestyle the sponsors wished to protect. These maps are referred to by Roy Merrens as *parochial maps*, the name reflecting their essential quality "of narrow coverage or viewpoint" (Merrens, 1974: 2). They are large-scale, designed to highlight features and areas of local interest:

> "The amenities parochial maps represent tend to be of the common-or-garden variety: they are facilities and services that may regularly be resorted to by the local citizenry at little or no cost, such as post offices, hamburger stands, play areas, vantage points, public washrooms, and drinking fountains" (Merrens, 1974: 2).

It is precisely these features that were put under most pressure by urban development projects, features that do not show up on ordinary maps. Parochial maps were an attempt to put people's everyday lives on the map.

In the late 1960's a number of massive development projects were proposed for locations along Toronto's waterfront, including office buildings and a major airport (Merrens, 1974). A citizens' group was formed, calling itself 'forWARD 9', and members successfully opposed the airport proposal. In considering how best to encourage greater use of and respect for the city's waterfront, members of the group decided to produce a map of the area. Called the People's Guide to the Toronto Waterfront, this map "was an attempt to look closely at what developers had regarded as a blank sheet on the designer's table... [drawing] attention to the human activity which had taken root along the water's edge" (Merrens, 1974: 5). 500 copies of the prototype were distributed in 1971, funding the production of a colour edition. Between 1972 and 1974 16,000 of these maps were sold for a price never exceeding 50 cents (Merrens, 1974).

The map itself was constructed not as a literal representation of Euclidean space but as a "composite of the mental pictures the authors carried of their own personal versions of the waterfront" (Merrens, 1974: 5). The map was deconstituted from the minds and hearts of the authors.

The form of the map was seen to be a break with cartographic tradition; indeed, the base map was drawn by cartographers who

> "were encouraged to jettison some of the standard conventions followed in drafting maps for scholars, in favour of devices that would make the map more readily legible to a wider and less cartographically literate audience" (Merrens, 1974: 6).

This is an excellent statement of the goal of reconstitution as presented in this thesis.

The authors were aware that their own vision was bound to be incomplete and so appended their own phone numbers in an effort to solicit information and suggestions for improvement. Here the group attempts to involve others in the deconstitution process. However, they also acknowledged that, for all their effort, "it was anticipated that the map would be hopelessly out of date within two or three years" (Merrens, 1974: 6). Because of this, distribution ended in 1974.

Merrens identifies two main results generated by the production and distribution of the map. Firstly, the experience of gentle activism encouraged a number of the citizens' group to enter local politics, where they had more say on what happened to their landscape. Secondly, the map signaled a new interest in the waterfront by Torontonians, giving rise to a number of people-centred ventures and uses. He then asks a relevant question:

> "What was the cause of the spate of parochial maps that began appearing in North American cities in the late 1960's? Why a somewhat similar kind of map should have appeared on the scene in a number of places, independently, spontaneously, and more or less simultaneously, is not entirely clear" (Merrens, 1974: 8).

Merrens himself unwittingly suggests a reason for the appearance and demise of these maps. Another map of Toronto's waterfront was produced in 1970, this time by the Toronto Harbour Commission, a body charged with regulating the central waterfront area. This body had been involved in some of the proposals that had prompted the forWARD 9 response. Such blatantly exploitative proposals reflected a way of thinking about urban space echoed in their maps. In contrast to the People's Guide, their official map "shows primarily property holdings and real estate boundaries, and while it is updated and revised every year, it is neither amenity-oriented nor available to the general public" (Merrens, 1974: 5). At other times in North American history such proposals went unchallenged, but in the climate of activism engendered by a growing environmental consciousness and the peace movement some sort of response was to be expected. The fact that this response often came through the map is an encouraging sign that people have not abandoned the map as a vehicle of expression. However, in the more conservative and materialistic 1980's such community-inspired products are fewer and further between.

One project that commenced in the 1980's was the Parish Maps Project, set up by Common Ground, an organisation in the south of England formed to promote "the importance of our common cultural heritage" (Sinden and Clifford, 1987: 109). The report on this project notes the repressive ways in which maps are currently used: the content of a map, Sinden and Clifford argue, is affected by those who make it and by its intended use. Even those maps produced in support of conservation are based on scientific and economic reasoning, "leading to an over-emphasis on the rare species and the spectacular landscapes to the detriment of the familiar and common things which are important in people's every-day lives" (Sinden and Clifford, 1987: 109).

The Parish Maps Project offer locals the chance to help draw their own maps, usually in the form of adding to a number of large, mural-like graphics. In this way people can depict those features which make their own localities important to them, things such as a traditional courting tree, a gate made of old agricultural tools and an old chalk quarry (Sinden and Clifford, 1987). This user input involves both reconstitution and deconstitution. The authors of the report sum up the project by saying:

> "The Parish Maps Project aims to explore the versatility of the map medium: to use the process of map-making as a way of encouraging people to take a fresh look at their immediate surroundings and familiar places; to identify, locate and express the wildlife, landscape, buildings, historical and cultural presences in their own defined territory which are of value to them, rather than to 'experts' from outside, and to communicate this to others" (Sinden and Clifford, 1987: 109).

The authors argue that the Project demands an active role on the part of the participants and viewers alike, with the goal "that we get involved in caring *actively* for our own places" (Sinden and Clifford, 1987: 110, emphasis theirs).

These responses are examples of how people might be put back on the map. Items of relevance to the everyday lives of people are reconstituted from the sort of data not normally represented on maps - data that are introspective, based on feelings not amenable to empirical analysis. These alternative deconstitutions have a number of features in common: (1) they are born out of a disillusionment with the form and content of existing maps; (2) they seek to preserve what is good and by so doing protest against what they view as bad; (3) they do this by promoting self-expression which (4) is at a local scale (apart from Watson); (5) they express a desire to communicate with others, (6) evoking active involvement by others in the landscape depicted and (7) participation in the mapping process itself.

There are, however, a number of practical problems with such an approach. These projects need sponsoring, either from the participants themselves for whom it can be an expensive exercise, or from outside organisations who then begin to influence the form and content of the maps, a familiar story repeated. The costs of producing almost any map are enormous when the time and energy needed to collect, produce and disseminate spatial data are considered. These costs may be recovered by a charge for the map (as with the People's Guide), or a project may limit cost by not making the map generally available (as in the Parish Maps Project, where maps are single copies only). This means that in spite of the best of intentions the maps are relevant only to a very few. Compounding this limitation is the datedness of most parochial maps, as they are difficult to revise and portray subjects that by nature are extremely changeable. Finally, each project has to find some way of overcoming people's preconceptions, encouraging those who think they know what a 'real' map is to give their work some credence. For deconstitution to be a viable proposition, these difficulties need to be overcome.

The Potential of G.I.S.

The answer to the difficulties faced by mapping projects encouraging user deconstitution and reconstitution would appear to be some sort of interactive computer system, such as a G.I.S. Undoubtedly, and in spite of the criticism leveled at such systems in Chapter Six, G.I.S. have great potential. One can envisage a system in which the user is presented with a variety of reconstitutive options from non-traditional databases. Morrison introduces such an example which points the way to greater flexibility of and access to information:

> "For example, at the entrance to each National Park will be a Dial-a-map booth. The user, for a prescribed fee, can specify which of several features are desired on the map. The data can be kept current; for example, daily road work locations, or sightings of wild animals within the last twenty-four hours, or locations of currently available camp sites can be instantaneously pressed" (Morrison, 1980: 21).

Of interest to this thesis is the flexibility of reconstitution suggested by Morrison's example and, importantly for this chapter, the relevance of the data deconstituted into his system. The ideas introduced by this example are crucial to the understanding of how G.I.S. might benefit the public rather than merely corporate users. These ideas are:

- ease of access (tempered by the cost of using the service)
- interactive display

- opportunity for individual customisation of maps
- regular revision of and addition to data.

Such a system addresses three basic problems in deconstitution: the issue of barriers to access to information; placing data selection in the hands of map users; and the on-going relevance of the map. David Rhind calls this *distributed cartography*, where maps are made "on an ad-hoc, on-demand, local and personally customised basis rather than on the basis of a central lithographically printed product" (Rhind, 1980: 33). At the beginning of G.I.S. research such ideas were broadly discussed, but the high cost of delivery systems and the need to curry favour with sponsors for such systems has narrowed these discussions (McCormack, 1987).

Nevertheless, a few systems exist which incorporate some of the features necessary to facilitate user involvement in deconstitution. One such system is Domesday, a British product commemorating the 900th anniversary of the original Domesday Book of 1086. This huge project involved the collection of textual and photographic data from school groups and individuals throughout Britain, and official data from a number of sources. These data were linked to Ordnance Survey maps of Britain for display, so that a user could 'map-walk' through the countryside, choosing a map segment and viewing all the text and images associated with that map.

Domesday is divided into two videodisks, the first of which is a local disk called the 'people's data base'. 80,000 images and associated text were collected by schools and linked to Ordnance Survey topographical maps at three scales (1:625,000; 1:50,000 and 1:10,000, for which incomplete coverage was available), to town plans and plans of some individual buildings. Ordnance Survey maps were chosen because of the cost of producing alternatives, and copyright restrictions were relaxed for their use. The second disk displays the more formal official data, from which thematic maps can be produced using an interactive mapping program.

The 'people's data base' mapping system is, therefore, a Ic/Tf map in terms of Figure 7.1. This combination of innovative informal data in the form of text and photographs is inadequately displayed by the orthographic maps used. In fact, the maps do nothing more than 'window' the data, acting as a reference framework from which data can be accessed. Ironically, a reviewer of the project commented that using the system would provide students with good training in skills needed to use maps: "as surrogate walkers they need to flip regularly between a plan view of the walk and photos of the environment itself" (Shepherd, 1988: 9). The system reinforces the separation between planimetric maps and the horizontally-and procedurally experienced environment. Had the project used procedural maps, it is likely that the map-walking exercise would have been a greater success.

The second disk is an example of a Tc/If map, where official statistics of the type usually portrayed in thematic atlases can be manipulated using a powerful interactive mapping tool. The project would benefit from an integration of the diverse approaches of these two disks, so that the more innovative personal data generated by schools could be displayed rather than just indexed by maps.

Another system embodying many of the necessary features was to be Heritage New Zealand: Nga Ohaki Aotearoa. Initially funded from money set aside for New Zealand's 150th celebration of the Treaty of Waitangi, Heritage cannot at present attract the necessary sponsorship. Its design overcame one crucial disadvantage of Domesday, that of being a 'snapshot', in that Heritage would allow users to view data from the entire spread of 150 years. It was designed as an exploratory information environment, which emphasised the integration of time and space for data retrieval (Forer, 1989). In this project, as in Domesday, the map is a "friendly front end" the significance of which "is in what it leads to, rather than what it directly portrays" (Forer, 1989: 5).

Particular strengths of Domesday and Heritage are the broad scope of their data gathering, involving many people, and the nature of much of the information gathered. Such information is not available in any other form. The amateurish nature of much of the data collection and input, with resultant loss of accuracy, is harshly criticised by a reviewer of Domesday:

> "Most of the contributions reflect the extremely parochial, highly selective and often whimsical concerns of individual schools, schoolteachers and schoolchildren... much of the factual information in the textual items is of dubious value" (Shepherd, 1988: 6).

However, the collection of informal data is seen by this author to be a virtue, allowing comparison between this and more formal data and providing expression for many people who have never before seen themselves on the map. Further, the project was seen by its creators as valuable for planners and decision-makers (Openshaw, Rhind and Goddard, 1985). Such planners will probably confine themselves to the national disk, but they need to know that the people they represent or will be affecting by their decisions are often parochial, selective and whimsical. It is these elements, among others, that are neglected by contemporary maps and yet help shape our spatial reality.

The two projects mentioned fall short of the requirements of user deconstitution and reconstitution in two main areas. While the breadth and quality of the data gathered was commendable, it is of a one-off nature with no facility for revision. This has meant that Domesday is now a historical rather than geographical piece of work, unable to show trends over time. The nature of the funding, based on special commemorative occasions, has influenced the projects to the extent that revision was never seriously considered. Secondly, users had little opportunity to contribute to the reconstitution of their data. In the Domesday project the maps were pre-drawn Ordnance Survey maps. Using planimetric maps, even with the addition of text and photographs, limits the extent to which people can locate themselves in the project.

The ideas contained in the 'Dial-a-map booth' suggested by Morrison (1980) have found little favour in practical projects. If the 'dial-a-map' analogy is used, the best of the projects succeeds only in connecting the dialer with the same selection of messages, messages that become increasingly irrelevant over time. These messages are all produced in the same language, one which is foreign to many prospective callers. And no-one but the original subjects get to contribute to the conversation. The map rapidly becomes a museum-piece, used by none but educationalists.

Construction of a User-Driven Geographic Information System

Figure 8.3 is an outline of a theoretical system that overcomes the majority of these inadequacies. Developed by the present author, it is a spatial database into which is placed information of relevance to a local community. It allows for on-going input from users, who are encouraged to contribute personal data to the system at the same time as they use it. These data are linked to maps which can either be planimetric or some form of transformation. Just what sort of data is of relevance to users is gradually determined by the users themselves, who can make suggestions for new topics as well as support those topics they consider worthwhile. The generator of the system has most impact at the beginning, but as the data collection gains momentum is reduced to an editorial role. Official statistics are complemented by the more informal, but in many ways richer, data from users. Reconstitution options are initially fixed at a small number of map choices, but can be expanded as users express preferences and as technology improves. It is from a user-determined, malleable system such as this that any relevant interactive deconstitution and reconstitution will come.

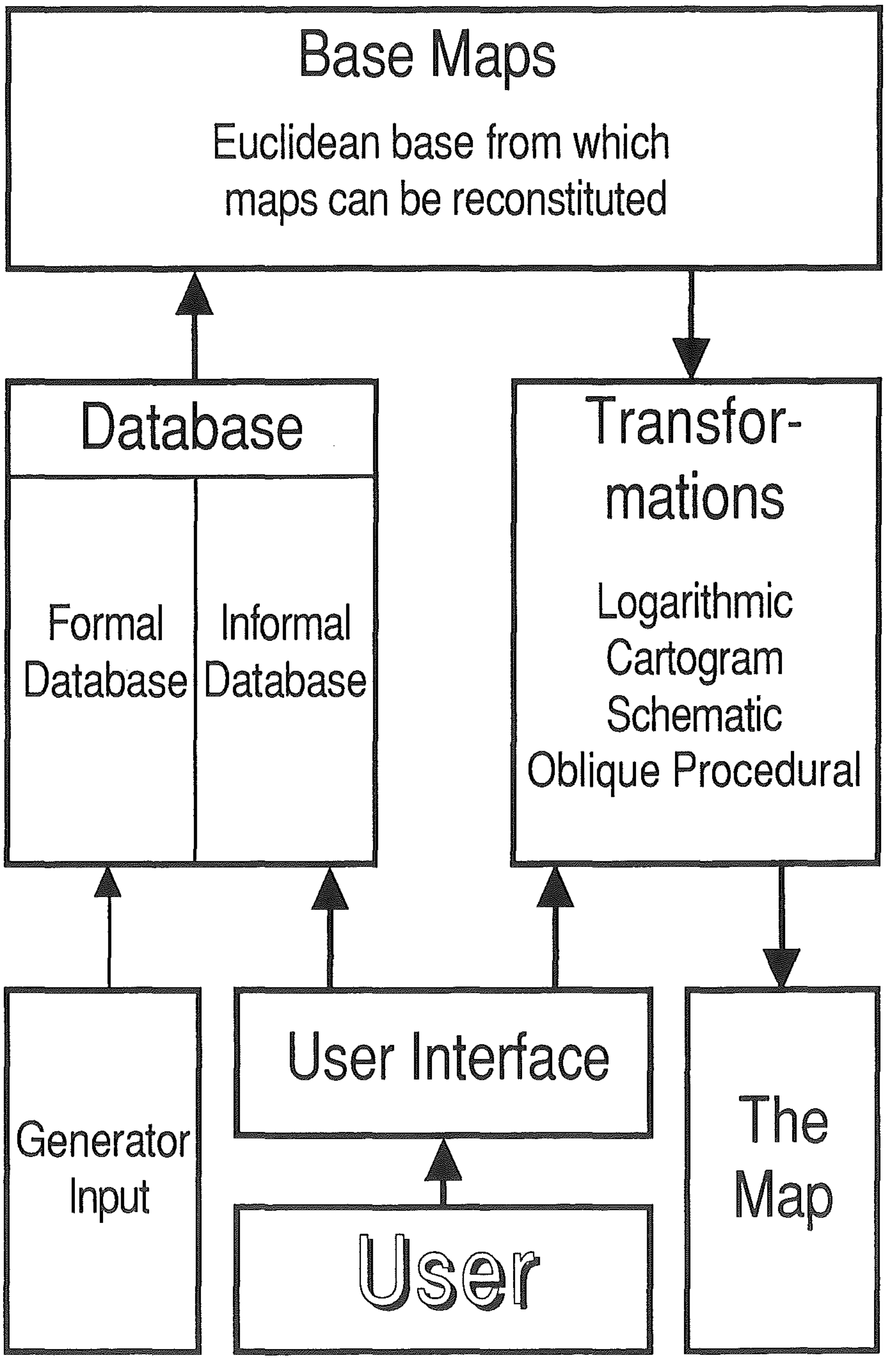


Figure 8.3. A theoretical User-Driven Geographic Information System (UD-GIS).

The discussion of map relevancy (Chapter 4) highlighted the non-iterative nature of contemporary map communication. Most other forms of communication are iterative to some extent: a telephone allows two-way conversation, radio has talkback sessions, and television now has its own shopping facility. As highlighted in Chapter 4, the map maker and map user seldom come into contact, preventing the user from influencing the form and content of maps. The single biggest advantage of using a computer-based system such as that outlined above is that it allows iterative interaction: the user can produce as well as consume map products, customising them for his or her own use during a single sitting.

Examples exist of systems that allow on-going input of and access to information. One such system, though not a G.I.S., is <u>The Cleveland Free-Net Community Computer System</u>. Begun in 1986, <u>Free-Net</u> has been programmed to allow access to anyone in the community who can use a computer and modem. A multi-user computer has been set up in the Telecomputing Laboratory at Case Western Reserve University, providing users with free information "about health care, education, technology, government, recreation, or just about anything else the host operators would like to place on the machine" (Grundner, 1989). The prototype attracted over 6,000 registered users and averaged 500 to 600 calls a day. All information that appears on the machine is placed there by individuals or community organisations, and is of the kind usually co-ordinated by City Councils or local government administrations. Its developers argue that <u>Free-Net</u> is a civic utility: "first and foremost, these community computer systems open up information services to very large populations that would not otherwise be able to afford it" (Grundner, 1989). The service was to be expanded in 1989 to allow access to 360 users simultaneously of a projected registered user base of 12-15,000 people.

While making access to information much easier for computer-literate people, this system disenfranchises those who do not have access to the knowledge or technology. Any system involving a computer faces this or similar problems: even if wide access is promoted, "most computer users experience computer systems as unfriendly, uncooperative and requiring too much time and effort to get something done" (Fischer and Lemke, 1988: 1). In fact, this disadvantage afflicts all flexible operating systems. It is regarded as a basic law of system design that in a flexible system everything is possible but nothing is easy, while in an inflexible, off-the-shelf system operations are easy, but very little of interest is possible (Hutchins, Hollan and Norman, 1986). One example of a flexible system in computing is a programming language, with which the experienced programmer can do many things but faced with which the novice must undergo a great deal of training. The opposite are 'turn-key' systems, programs which allow the user to perform set tasks with ease but which are not user-modifiable. This analysis suggests that to enable novice users of a computer system to manipulate a flexible program, the goal of Figure 8.3, is a problem not easily resolved.

Given that potential users can be supplied with the technology, there are guidelines that can help a system developer produce a system that has some flexible elements yet retains an overall ease of use. Shneiderman (1987) emphasises consistency in the display seen by the user and his or her interactions with the computer (called the *interface*). Consistency within a program reduces training time substantially as users quickly learn how the machine will behave. Above all, he argues, "novices need simple, logically organised, and well-labeled displays that guide their actions" (Shneiderman, 1987: 71). Other guidelines for development of an effective user interface include:

- extensive prompting for novices
- prioritising of functions to avoid function overload
- providing multiple paths so as not to disadvantage experienced users
- making fundamental functions easy to learn
- making frequently used functions accessible and easy to perform
- encouraging experimentation
- using default settings to guide and warn users (Brown, 1988).

A concept crucial to a successful G.I.S. is the display of graphics. The human ability to extract information from graphics is much more fundamental than the ability to extract from verbal or arithmetic data (Schmid and Schmid, 1979).

Once these general guidelines are incorporated into the system design, consideration should be given to specific features designed to help users keep track of where they are. Lin Brown (1988) provides further principles to this end:

- provide evidence of where in the program the user is
- display the title of the current operation
- acknowledge progress
- acknowledge successful completion
- don't leave the screen blank
- display a list of the currently active options
- indicate how users can continue.

The use of such features helps the user feel less 'at sea'.

It is highly unlikely that even a slavish adherence to the above guidelines will produce a system system that gains user satisfaction in its first incarnation. Instead, system design, particularly interface design, is likely to be an iterative process: "iterative design is a critical component of the user testing and prototyping development cycle" (Brown, 1988: 188). While evidence suggests that consultation of naive users at every turn does not produce better systems (Carroll and Olson, 1988: 56), strong arguments can be presented in favour of user involvement, especially at the testing stage. Allowing user feedback promotes debate about design decisions, gives users a sense of participation, may provide the authors with elements they have overlooked, and encourage increased user acceptance of the final system. It may, however, lengthen the implementation period, increase costs of development and perhaps build antagonism between users and developers if suggestions are not accepted (Shneiderman, 1987).

Evidence of the need for iteration and user consultation in the design of maps is provided by Wright, Lickorish and Hull (1990). Their study of the development of a hand-held location map of clinics within a hospital Outpatients department indicates that some of the information on the initial map was misunderstood or ignored. After some twenty revisions were made, a revised map performed much more satisfactorily but the introduction of new information further complicated the users' tasks. Their research suggests that empirical evaluation of the use of the map is the most effective way of judging its worth.

Such testing can be done effectively if the right criteria are measured. Shneiderman (1987) advises that at least five elements of user interaction with any system should be measured:

- the time taken to learn specific functions
- the speed of task performance
- the rate and magnitude of errors
- a subjective measure of user satisfaction
- the retention of commands and procedures over time.

These criteria will be the basis upon which the mechanics of any user-driven interactive mapping system will be judged.

Most of the material written about computer technology and geography is "acritical and concerned with the practical implementation of computing" (Chalmers and Forer, 1987: 150). In the light of criticism leveled in this thesis against the impositional use of maps in society, mention must be made of the possibility that silicon technology might be used in a similar manner. The incursion of computers into modern western life means that "fewer and fewer people live outside the 'computer culture'" (Chalmers and Forer, 1987: 150), and though education lags somewhat behind technology a new computer-literate generation is rapidly rising through the ranks of middle management. There is no mechanism available to prevent exploitation via computer, with no code of ethics allowing policing of abuse.

A more subtle influence of computer technology is its acceptance as a new instrument of global and social oppression. Multinational companies, in particular, depend on the instantaneous reallocation of resources to bolster the unequal development necessary for their profitability. At a societal level lower socio-economic groups, women and non-Europeans seem to be comparatively disadvantaged in their access to computer technology, with a new jargon and new skills ostracising people, including the elderly, who do not learn them. It is therefore imperative that any system designed to facilitate user deconstitution and reconstitution is not surrendered to controlling interests, either through sponsorship or sale, but remains community property. While this thesis does not directly examine how this might happen (though the concluding chapter offers some suggestions), control of such systems by those who contribute to them may be the only safeguard preventing exploitation. It is hoped that the development of a 'user-friendly' interactive mapping system will minimise the number of people disadvantaged by not being able to use it.

Conclusion

A number of motivated individuals and organisations have produced and conducted the production of alternative deconstitutions of spatial data in response to the ubiquity of exploitative orthographic map content. Some of these deconstitutions were produced to point out the deficiencies of contemporary maps (such as Watson's map), while some had the facility to include many other users in the deconstitution process (e.g. Domesday).

Many people are not so motivated or assertive, nor do they have the education, finance or facilities, to conduct their own deconstitutions. However, they may respond to the efforts of others if they are included in the process. Such inclusion may be possible, within current technological and computer-literacy limits, to produce a computer-based system which enables users to deconstitute and reconstitute reality on an on-going basis. An interactive mapping system may be the best option available to avoid the pitfalls of most paper-based maps and one-off computer mapping systems.

Pursuing these ideas further leads directly to the next chapter in which an interactive user-driven mapping system, Tourist Info, is constructed. Discussion in this chapter stands in its own right, but it also prepares the reader for the empirical analysis of Chapter Nine in which concepts from the present and the previous chapter will be tested by conducting field tests with Tourist Info.

Chapter Nine

Tourist Info. Towards a User-Driven Geographical Information System

Introduction

The subject of this chapter is a User-Driven Geographical Information System (UD-GIS) designed by the present author. Called *Tourist Info*, this software was specifically authored to find out whether a UD-GIS would attract users, and to test issues relating to deconstitution and reconstitution. Specifically, the following points will be examined:

Use of a UD-GIS:
- The extent to which unsolicited users will use a UD-GIS;
- Who the users of such a system are likely to be (by age, gender, familiarity with computers).
- The types of qualitative user reaction both to the machine and the program;
- The extent to which the system needs to be modified;
- The extent to which the system *can* be modified; and
- The number of iterations needed to produce a satisfactory outcome.

Deconstitution:
- What data are of interest to these users; and
- The amount and diversity of input that users are prepared to contribute.

Reconstitution:
- What sort of maps are favoured by users to display their data; and
- Whether users suggest improvements in form and content.

These ten points are important in an assessment of whether a UD-GIS will offer any solutions to the problems caused by generator dominance of cartography (statement 2). The provision of potential for user data entry provides an opportunity for non-empirical data, such as values, judgements and feelings, to be amalgamated into the system (statement 1). Collecting data on the types of reconstitutions favoured by users will add to the discussion on the merits of different perspectives begun in Chapter Seven. Measurement of the extent to which people make use of the system, and a profile of these people, will aid analysis of the potential of UD-GIS. Most importantly, such data will enable the present author to establish whether people who may have trouble with traditional maps can make use of a UD-GIS (statement 3).

This chapter is comprised of three main sections. The first reviews the history of this software, recounting how prototypes of Tourist Info have evolved from the theoretical model of the previous chapter (Figure 8.3.) as an embodiment of the aims of this thesis. Tourist Info itself is the subject of the second section, which describes the limitations, unique attributes, user interface and underlying routines of the software and hardware combination actually tested. From this, the discussion moves into the third section which focuses on the public testing of Tourist Info. The results of this discussion lead to some evaluative comments, not all of them favourable, regarding the use of such systems in facilitating greater user involvement in the deconstitution and reconstitution of cartographic material.

The Evolution of Tourist Info

CustoMap

The first steps towards developing a UD-GIS were taken in June and July 1989, with the development of a computer simulation containing some of the theoretical elements of Figure 8.3. Named CustoMap, this simulation was constructed by the author using an Apple® Macintosh® Plus platform and HyperCard™ software. Figure 9.1. is the introduction screen for the program. The simple reasons for choosing this combination of hardware and software were (1) the author owned the machine, and (2) HyperCard allowed easier programming than any other software. This was important because the author had little programming experience. HyperCard, a partially object-oriented programming language and graphical display engine, enables the programmer to change the attribute of any object in the program independently of the rest of that program. This greatly simplifies construction.

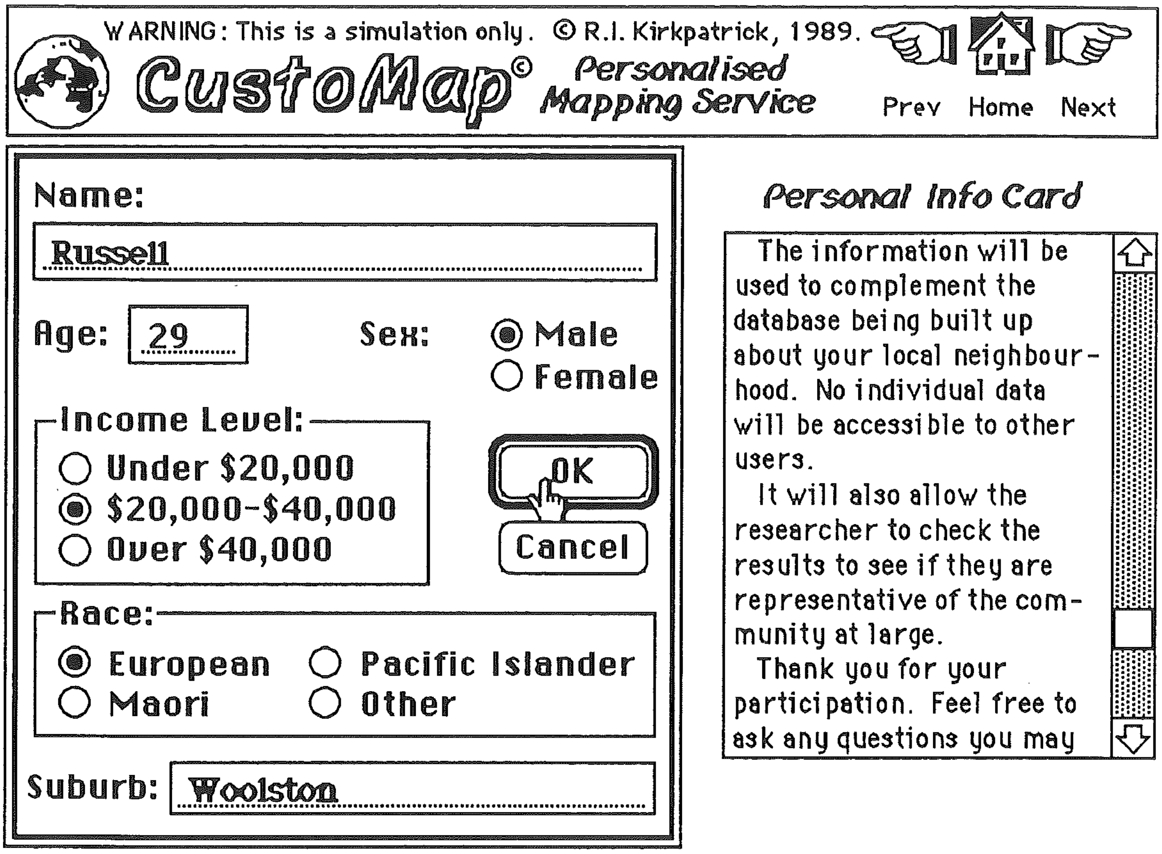


Figure 9.1. The Introduction Screen for CustoMap.

CustoMap was envisaged as a community-based system, providing information of interest to a local community, such as a small town or a suburb of a city. It was to answer such basic questions as "where are the doctors located?" and "which areas are best to avoid at night?" The first question could be answered by input from formal data sources, but the second required some kind of data collection mechanism so that people using the system could themselves supply the answer.

CustoMap was to allow alternative reconstitutions. The limits of the software meant that real-time transformations of map projections were ruled out, but two types of projection, planimetric and logarithmic, were implemented. At least three more were envisaged (Figure 9.2). Deconstitution was to be a combination of map generator-provided formal data and solicited informal data, the example of the latter in the simulation being feelings of fear. A simple click on the map (Figure 9.3.) selected a safe or unsafe area, in the opinion of the user, which was recorded in a database and would theoretically be available for display on an aggregate fear map. In this way the system built up user-contributed data.

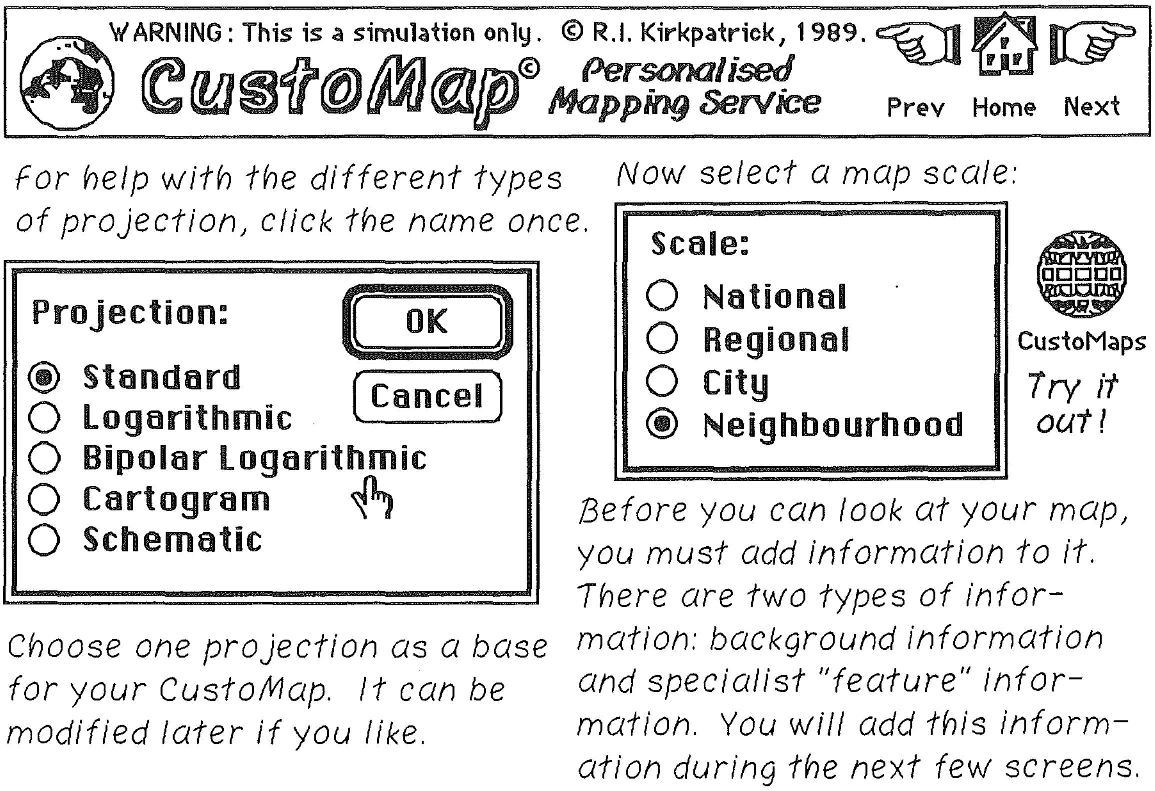


Figure 9.2. Choosing a Projection in CustoMap.

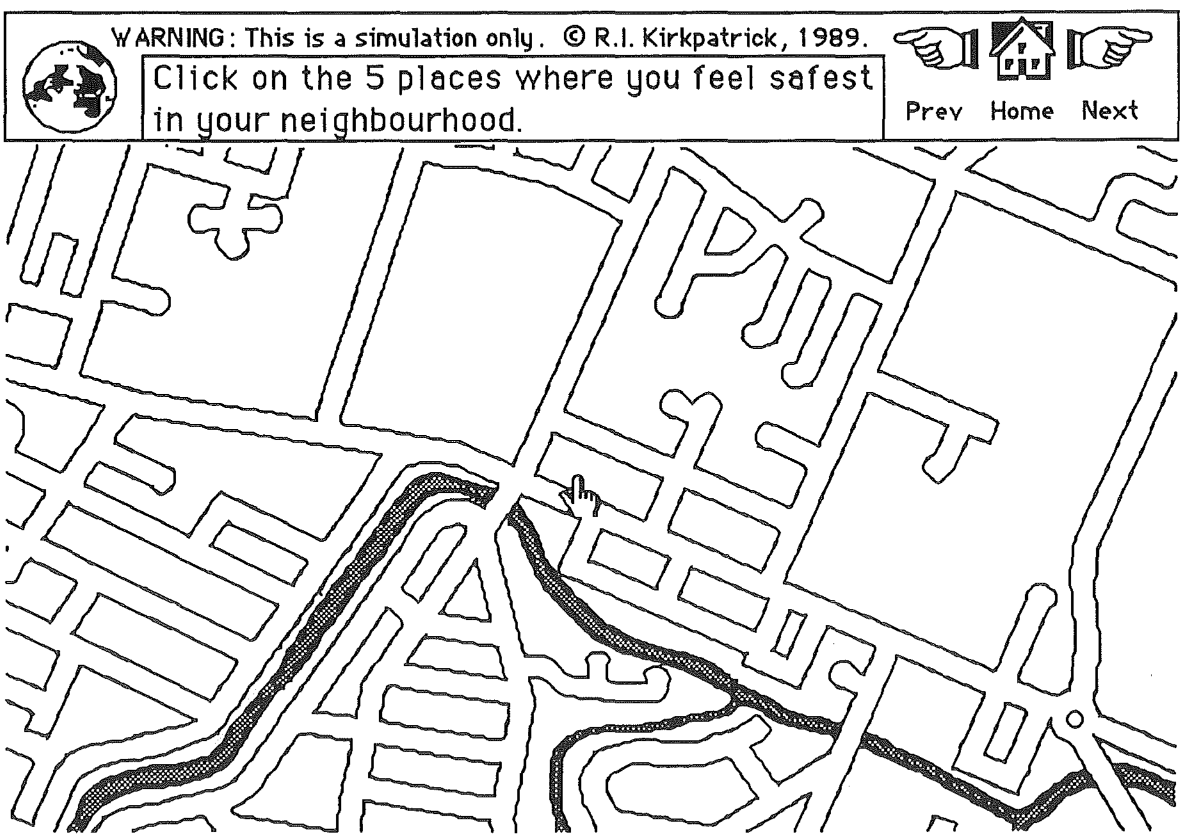


Figure 9.3. Entering informal data in CustoMap.

This simulation was built primarily to communicate the ideas behind the theoretical UD-GIS. CustoMap was the first attempt to construct a user-friendly interface. Being a simulation, it was not tested in any fashion, but criticism and advice was received.

A Geographer's Guide to Dunedin

The Fifteenth New Zealand Geography Conference, held in Dunedin in late August 1989, presented the author with an opportunity to test his ideas with sympathetic subjects. A small program, entitled A Geographer's Guide to Dunedin, was hastily assembled for the conference. This program consisted of one map only (Figure 9.4.), and therefore provided no alternative projections for reconstitution. The map projection was planimetric, chosen as a time-saving measure rather than for any specific merit. However, the purpose of the program was to test deconstitution, not reconstitution.

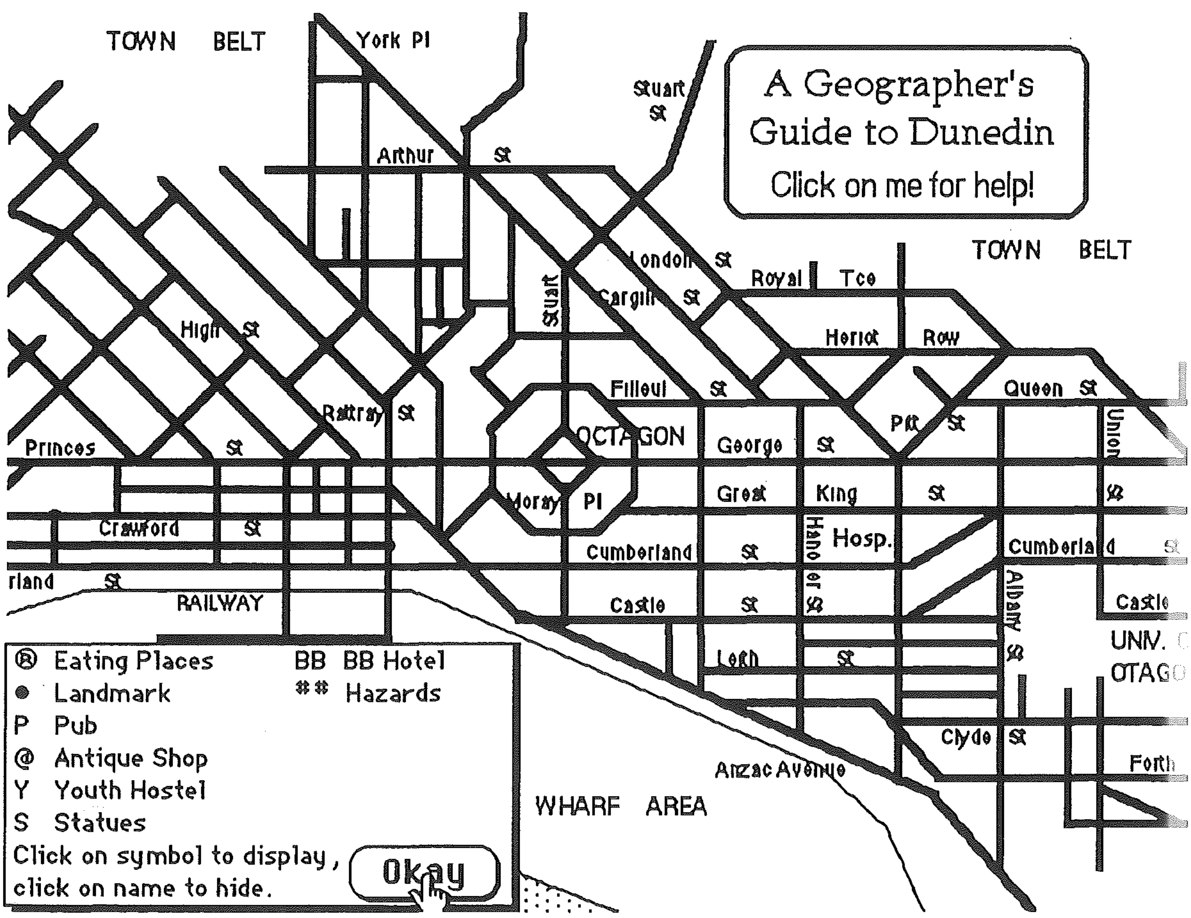


Figure 9.4. The introduction screen for A Geographer's Guide to Dunedin.

Once again the development of the software was done using HyperCard and the Macintosh Plus. In 1990 terms this machine has limited processor capability and displays only black and white images, but has the advantage of portability. The machine was set up in a foyer area between the lecture theatres where the conference was taking place, and its presence was advertised during sessions.

The software allowed users to locate any place or feature they wished on the map, and write something about it in a text box linked to that location (Figure 9.5.). This was in turn linked to a key, which allowed other users to re-call to the screen any previous uses, simply by clicking on the symbol in the key and displaying all of the location in that category. A click on any individual symbol opened the text box relating to that location. Other users could extract this informal data and add to it if they wished. Importantly, there were no pre-determined categories, the instructions merely suggesting that the users might like to locate and comment on any feature of interest to them. Of primary interest to the author was whether the geographers would be willing to enter data about *their opinions* of Dunedin, or merely enter factual material. Related to this was the question of capturing interest: how much time would people invest in the program?

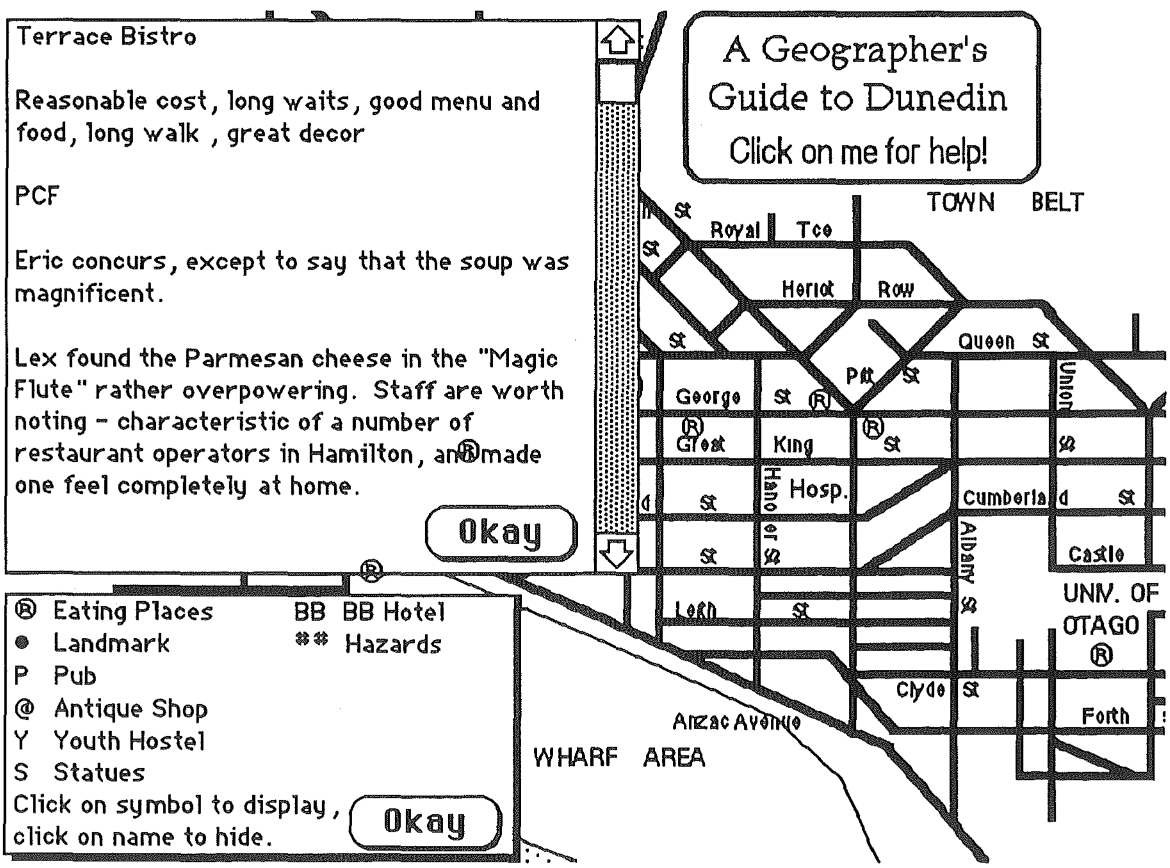


Figure 9.5. Data Entry box with eating places displayed, A Geographer's Guide to Dunedin.

Thirty-two separate people made use of the program in the hour or so it was available (six ten minute periods between sessions). They spent an average of three minutes each with the program, a result probably enhanced by their presumed geographical curiosity but deflated by the pressure of time. Most of the users made some sort of data entry and categories emerged at the end of the exercise. The author played an editorial role in grouping like features into categories. In every case the user was curious enough to make direct use of the program him or herself, taking control of the input devices (mouse and keyboard) or using the mouse to point and allowing the author to type their entry on the keyboard.

The program had a number of obvious flaws, of a technical rather than a conceptual nature. The text boxes did not hide the symbols displayed behind them, and were not visually linked to the symbol they referred to. For example, in Figure 9.5. the Terrace Bistro has been selected by a mouse-click and information for that feature is now displayed. It is not possible to tell, however, which of the eating places shown is the Terrace Bistro, confusing both for those using the system and anyone else watching. The symbols were small and difficult to distinguish from the background, in spite of their being few. This suggested that any visual improvement would be linked to a colour display.

The major disadvantage of A Geographer's Guide to Dunedin was that it could be used only at this conference. Because it contained no formal data, none would use the system but geographers seeking to encourage the author in his studies. Narrow in scope, limited in applicability, inaccessible save to a few geographers, A Geographer's Guide to Dunedin nevertheless gave some insight into how people might react to a deconstitutive task. The author was pleased to note five outcomes:

- a high rate of participation
- a significant average amount of time spent with the system (three minutes out of a maximum of ten minutes between sessions)
- not one person reported difficulty understanding the concept or coping with the interface and data entry
- a wide range of subjects entered on to the map
- some people using the information provided by others as a basis for their own actions (such as selecting a restaurant).

This last outcome was particularly significant. If such a system encourages the use of informal data in decision-making it could possibly become a self-generating community resource. That is, people both use and enter informal data, which allows the system to grow in ways not envisaged or controlled by the generator of the system. Thus the determining role of the map generator might be circumvented.

Moreover, the use of such data in decision-making might help overcome the tendency to rely on quantitative data in formal planning decisions. Were a community-wide database and 'bulletin-board' system available, planners would have available to them a resource containing the sorts of subjective opinions that are normally ruled out of court. The use of such a system may help legitimise these opinions, thereby introducing a greater level of community participation into the planning process.

City Info

The Dunedin pilot test encouraged the author to begin developing a more powerful system, one which could be used with members of the general public. Central to this version of a UD-GIS was the notion of real-world testing: the program was to be developed to answer unsolicited spatial questions. This was to counteract the stimulus-response nature of many testing procedures, and in line with modern testing methods (Wright *et al*, 1990). Users were not to be asked to approach the system, instead being encouraged only by ostensive information from the system itself and associated written advertising. In this fashion it was hoped to avoid the laboratory-conditioned response common when subjects are isolated from their environment and presented with a task of little importance and/or benefit to them. City Info was designed between September 1989 and January 1990, primarily to gain financial support from New Zealand's Apple Computer distributor, CED.

Before this time, it was envisaged that A Geographer's Guide to Dunedin would be the last use of the Macintosh platform. Substantial University Grants Committee funding had been allocated to the project under an original submission which acknowledged the author's lack of expertise in software development. Money was provided to pay a programmer to use Acorn's Archimedes platform, a more flexible if more difficult programming environment than HyperCard on the Macintosh.

Two problems with this original plan manifested themselves. First, it proved difficult to communicate to potential programmers the nature of the concept. Second, and more serious, it was realised that once the program was finished there would be little chance for iteration. If some component proved inhibiting to people's use of the system, the programmer would have to be re-hired in order to make the necessary changes, With up to six iterations normally required in a design exercise of this type (Wright *et al*, 1990), such an eventuality would introduce unacceptable delays in testing procedures. Iteration had been identified as a crucial component of interactive map communication, and the author considered a measurement of the amount of iteration required to produce a satisfactory system to be a necessary part of the testing.

This led to the most significant logistical decision of the project. It was recognised that a choice existed between a more fully functional system developed on the Archimedes or a similar platform, with a concomitant decrease in the amount of iteration possible, and continuing to develop a system that was more restricted but allowed iteration to be achieved more easily based on the Macintosh. Bearing in mind that, within the bounds set by this thesis, it is not necessary to construct a definitive system and prove its practicality in all situations, the latter option was chosen.

The need for a larger, colour display and faster processor soon became apparent. This entailed the procurement of a more expensive machine than the author currently owned, so development of City Info was aimed at gaining sponsorship from CED. Rather than making the system fully operable (including revision to use a colour monitor on the machine sought), just enough of the program was written for demonstration purposes. In hindsight, this was a serious error, for two reasons. The possible influence of a sponsor on the constitution of the project had not been considered: such a sponsor might demand changes which compromised the minimal generator input seen by the author as a primary goal. Secondly, it turned out that CED had spent their available sponsorship funds at the time of application and, while they expressed interest in the project, could not sponsor it. The author was then left with a system that was not operational and no platform to run it on.

Before describing the events which led to an operational system being developed and tested, the major features of City Info will be reviewed. The decision to use the Macintosh platform was made more reasonable by the coincidental announcement of a HyperCard derived product called SuperCard, which was more flexible and powerful and could run in colour with much less difficulty. The single biggest advantage, however, was SuperCard's ability to display more than one window on screen at a time. Fortunately, the programming languages running SuperCard and HyperCard are very similar, minimising the time required to become familiarised with the programming environment.

Two decisions which had to be made before development could start were *what* formal information the system would display, and *which geographical area* the system would focus on. The larger and more diverse the area under study and the broader the topics the system could deal with, that is, the closer it approximates reality, the more general the user requests would become. It was feared that this would enlarge the scope of the project beyond that which could be accomplished in the time frame available. However, if the geographical area and topics of information were too small and focused, the experiment would bear too little resemblance to reality and more to laboratory conditions.

To articulate more cogently the compromises involved in combinations of site size and database diversity, three scales of research were considered:

1). City-Wide and large database diversity.

Both the formal and informal databases would contain many topics and would attract a full diversity of spatial queries. This in itself is a difficulty. If people thought the system would answer all of their questions, disappointment and disillusionment might prevent continued use. There were difficulties anticipated in collecting a wide range of formal data on a city-wide basis: time , financial and logistical. At best formal data would be patchy at this scale. Finally, the large area makes providing alternative reconstitutions more difficult.

2). City Centre and a focused database.

The city centre has a number of clearly defined functions which bring people in. These specific functions could be incorporated into the system (e.g. retail, tourism, banking). This would limit the general applicability of the system but would be adequate for an initial test. Reconstitution would be made easier at this scale as the city centre is usually more clearly mapped than any other area.

3). Neighbourhood and large database diversity.

Because of the smaller anticipated number of users of a neighbourhood UD-GIS, the large range of topics might not allow the collection of enough information on any one topic to allow meaningful reconstitution of that topic. Mapping of a neighbourhood should prove relatively straightforward.

It seemed that any system developed for research purposes should not contain more than was necessary to complete that research. With this in mind it was decided to limit the topics to a small number of well-defined categories. What those categories were to be depended on the area chosen for the test.

The city centre was chosen as a compromise between the three options, a decision made easier by the discovery of an oblique map of the central city. The Town Planning division of the Christchurch City Council publish an axonometric projection of the central business district of the city. This map was made available to the author at no charge.

Two types of data input were provided:

1). *formal:* put in by the author as map generator from publicly-available information. This information was not customisable by the user. It could, however, easily be altered by the system's editor.

2). *informal:* a space below the formal information was provided for users to enter their comments about the feature selected. It must be clearly noted that this information need not be specifically spatial in nature, nor need it be specifically tied to the map. That is, no specific mechanism was produced to display the informal data itself on the map. Instead, the maps would display the categories of places for which informal data was available. This was an important compromise made initially to avoid exceeding the software memory limits.

Three choices were offered for reconstitution. A standard planimetric map of the city centre was accompanied by an oblique procedural map (the City Council's Axonometric Projection) and a number of horizontal street-level animations between selected sites. It was hoped to test user reaction to vertical, oblique and horizontal reconstitutions in the same system, observing which was favoured for specific user-chosen tasks and for what reason.

The choices made by users would be counted by a built-in logging system. This was not included in the demonstration version.

The demonstration version did not achieve the intended result with CED, the Apple distributor. Nor was it well received by the Canterbury Promotion Council, in whose premises it was hoped to run the program. Those who evaluated the software objected to the informal database facility, being concerned that users might comment negatively on aspects of the local business and tourist environment. No compromise could be reached on this issue, with the author seeing the informal facility as being crucial to the project. Indeed, to acquiesce to requests to omit this facility would be allowing an unacceptable level of generator control.

Tourist Info

In February 1990 the Geography Department made funds available which, when combined with the UGC research grant, made possible the purchase of a more powerful colour platform. Between April (when delivery of the platform was taken) and July 1990 a refined, colour version of the software was written by the author. Potential users were presented with this version in August and September 1990. The software was called Tourist Info, reflecting a narrower subject focus of the database. The general outline of the system is first to be discussed, followed by the technical aspects of the system, including two of the more important routines and aspects of the user interface. Results and analysis precede an overall assessment of both this system and UD-GIS as a genre.

General System Outline

The outline of the Tourist Info system varies somewhat from that postulated in Chapter Eight, mainly through a combination of time constraints and software/hardware limitations. The system design of Tourist Info is shown in Figure 9.6.

The system is initially set up by a map generator, in this case the author, who is responsible for the provision of the map projections and formal data. Users begin to interact with this combination of maps and data, changing the makeup of the project by informal data entry and suggestions for better maps. The role of the generator is reduced to that of *editor*, removing malicious comments (there were none) and providing programming expertise to implement the wishes of the users. During the duration of the testing for this thesis the role of the author also included monitoring a *data logger* which recorded the choices of users of the program, and noting and recording more qualitative responses, such as unease with the technology.

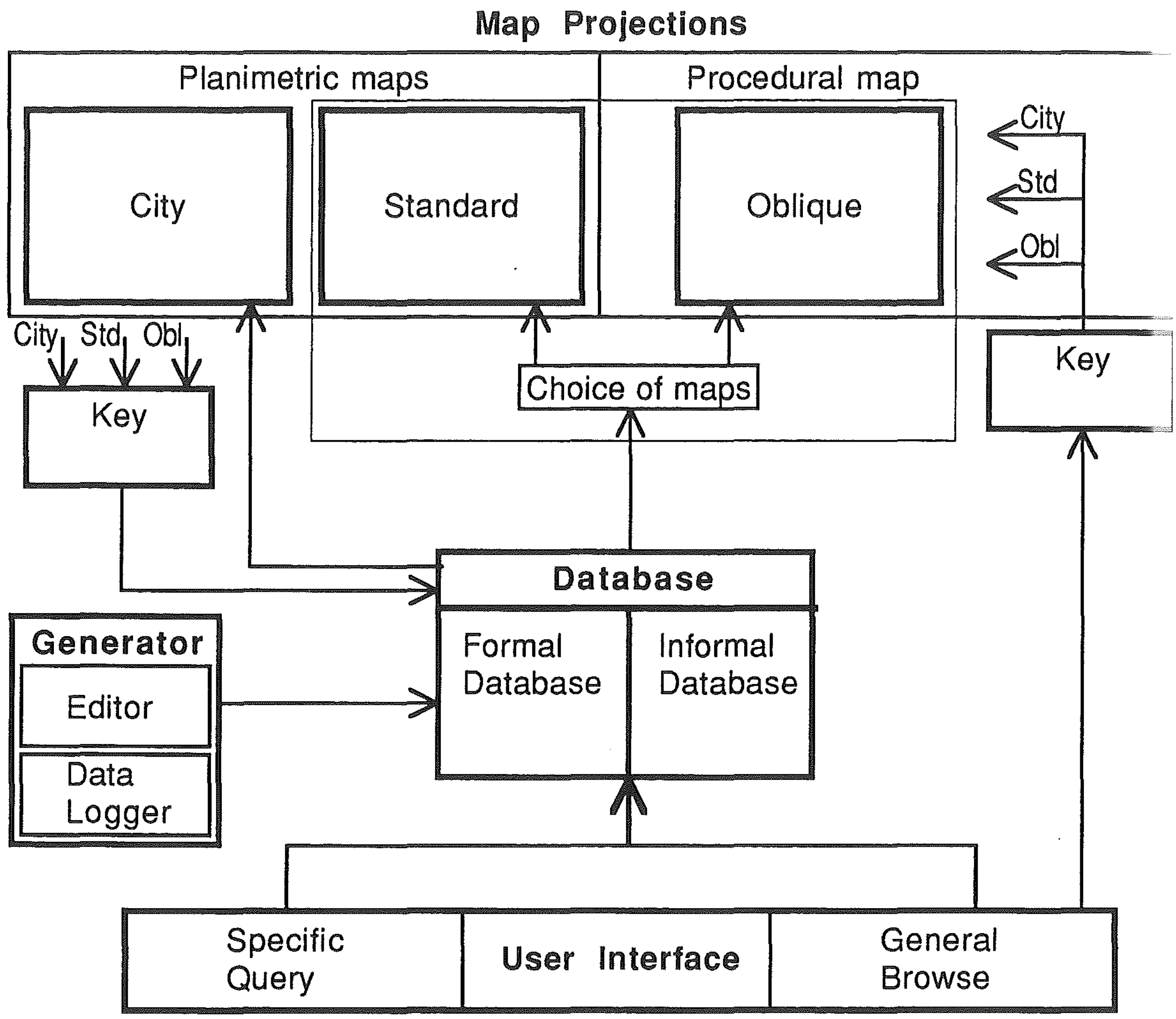


Figure 9.6. Tourist Info system design.

Following the decision made during the development of City Info to limit the topics covered to a small number of well-defined categories, it was decided to focus on *tourists*, a smaller but well-identified subgroup of potential users with clearly defined needs, many of them spatial in nature. More than any other single user group, tourists need to know where things are. Six topics of potential interest to tourists were chosen: *Accommodation, Attractions, Nitespots, Restaurants, Transport* and *Travel Agencies.* During initial testing it became clear that the sixth category was of little interest, and so was not developed.

At the outset of development two maps were envisaged: a *planimetric (standard) map* and an *axonometric (oblique) map* both covering the central city. The idea of a horizontal perspective, developed as a 3-D animation in City Info, was reluctantly abandoned due to the amount of time necessary for its development. Each 'City Walk' would have consumed many hours of photography, scanning, retouching and implementation, taking up large amounts of disk space and research funds. However, the two remaining maps were added to later in the project when the decision was made that, in order to attract a greater number of users, information would be provided for the whole city. A *city-wide planimetric (city) map* was provided to display this data. After the first two weeks of testing a further map was added at the request of users, showing city *bus routes.* It is a computerised version of Figure 7.28. The total number of maps available at the end of the project was four: two planimetric, one oblique and one schematic. These divide neatly into two Euclidean and two non-Euclidean maps.

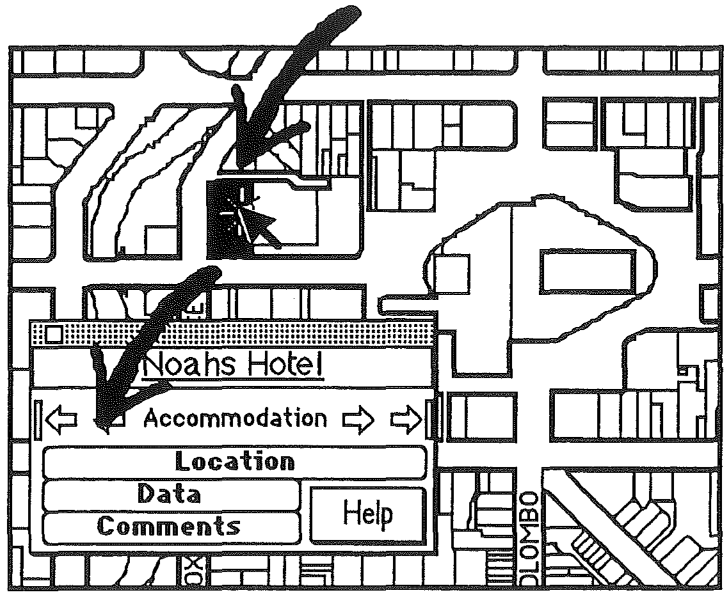
The database is much as implemented in City Info, consisting of complementary *formal* and *informal* data. However, users are generally limited to commenting on only one facility at a time, rather than a class of facilities (such as the state of restaurants in general). The potential existed for this limitation to be removed, but it was not suggested by any users, who included in their ranks a professional restaurant reviewer.

The user could access the system with a *specific query* ("where can I get a good Chinese meal?") or with the intention to *browse* through the program. Both the formal and the informal database could be easily accessed and information extracted, and users could add information to the informal database. The formal data could not be modified by the user.

Specific queries took the form of *information* about a facility or a class of facilities, or *location* of a facility or a class of facilities, or some combination of both. The program requires the user to make the distinction between informational and locational queries at the beginning of a *session* (the word for a single user interaction with the computer). The informational queries could stop at the database itself or could, at the user's request, proceed to the display of that data, while the locational queries travel automatically (and transparently) through the database and go straight to the maps. Once again, however, at the user's request the database could be accessed from the maps either through a key, for categories of facilities, or through *'hot spots'* on the maps, for individual facilities. These 'hot spots' are actually user-clickable buttons which, when activated, display the information relevant to the facility clicked on (Figure 9.7).

A general browse was possible using the browse palette (Figure 9.8). This palette, accessible from the first screen, enabled the user to look at any map, access hot spots and thereby the database; display categories of data on any of the maps by using the key; and directly access the database.

Comprehensive on-screen assistance was provided, with separate *help* windows accessed by one mouse click. Examples of help facilities are shown in Figure 9.9. This assistance was complemented by the presence of the author as operator.



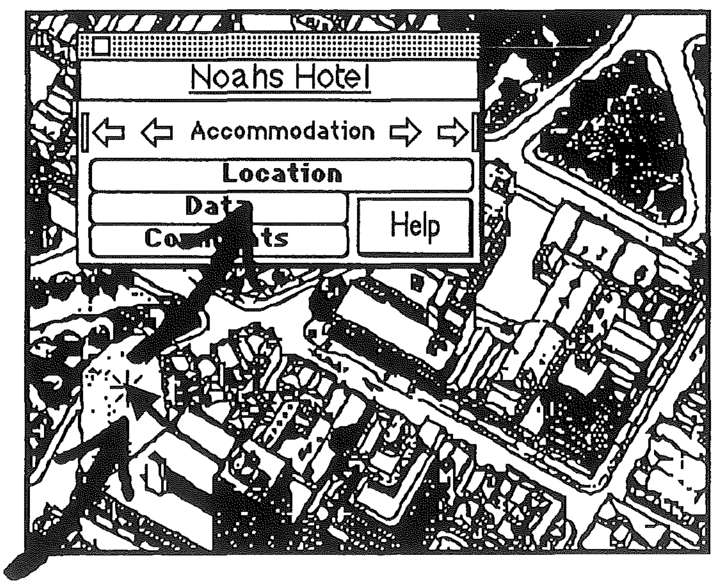


Figure 9.7. Using 'hot spots' to display information, standard (above) and oblique (below) maps, Tourist Info.

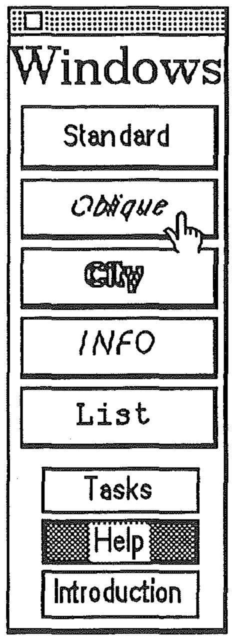


Figure 9.8. The Browse palette, Tourist Info.

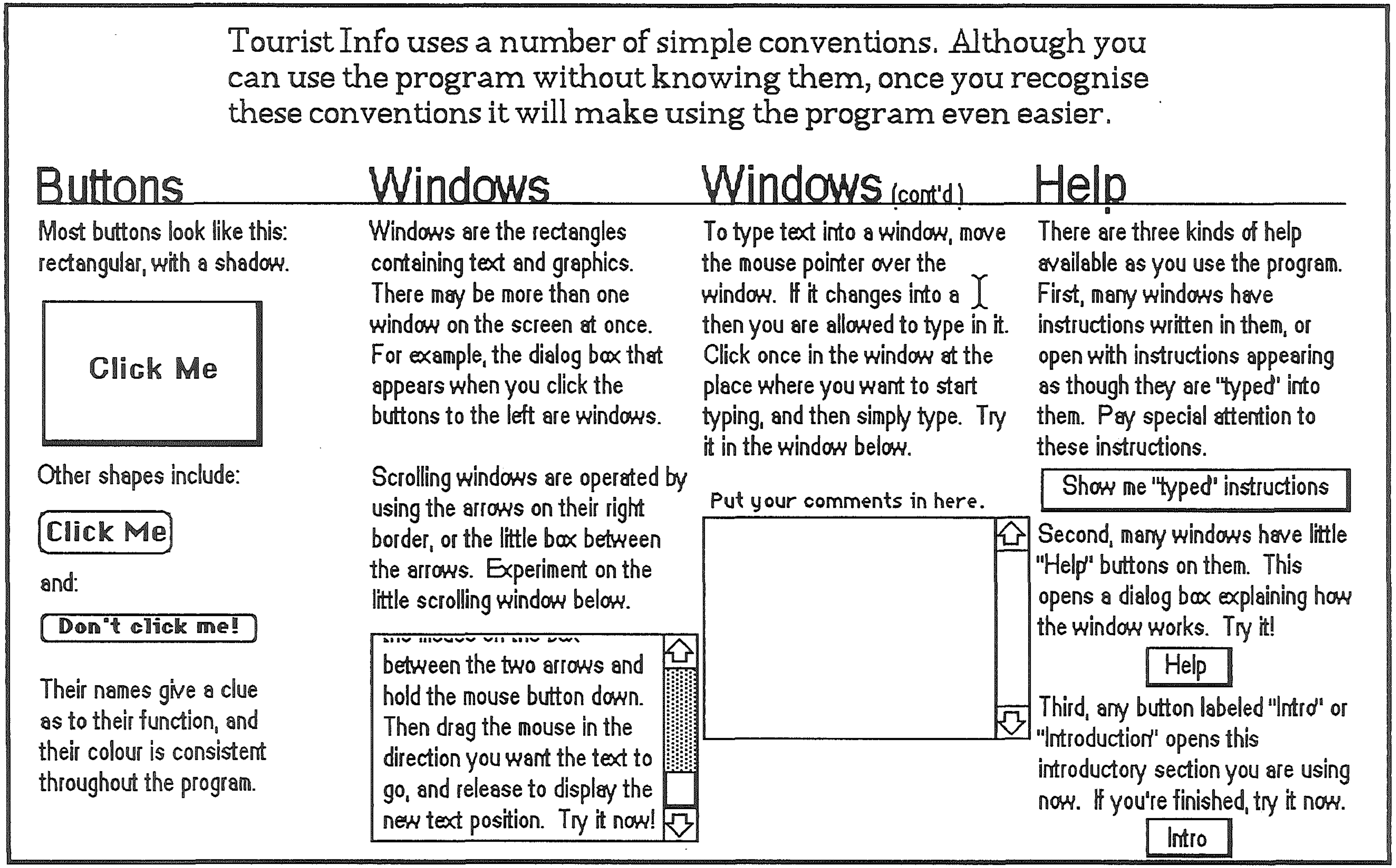


Figure 9.9. Tourist Info Help facilities. Above: the introductory Help window. Overleaf: an example of an on-screen Help facility.

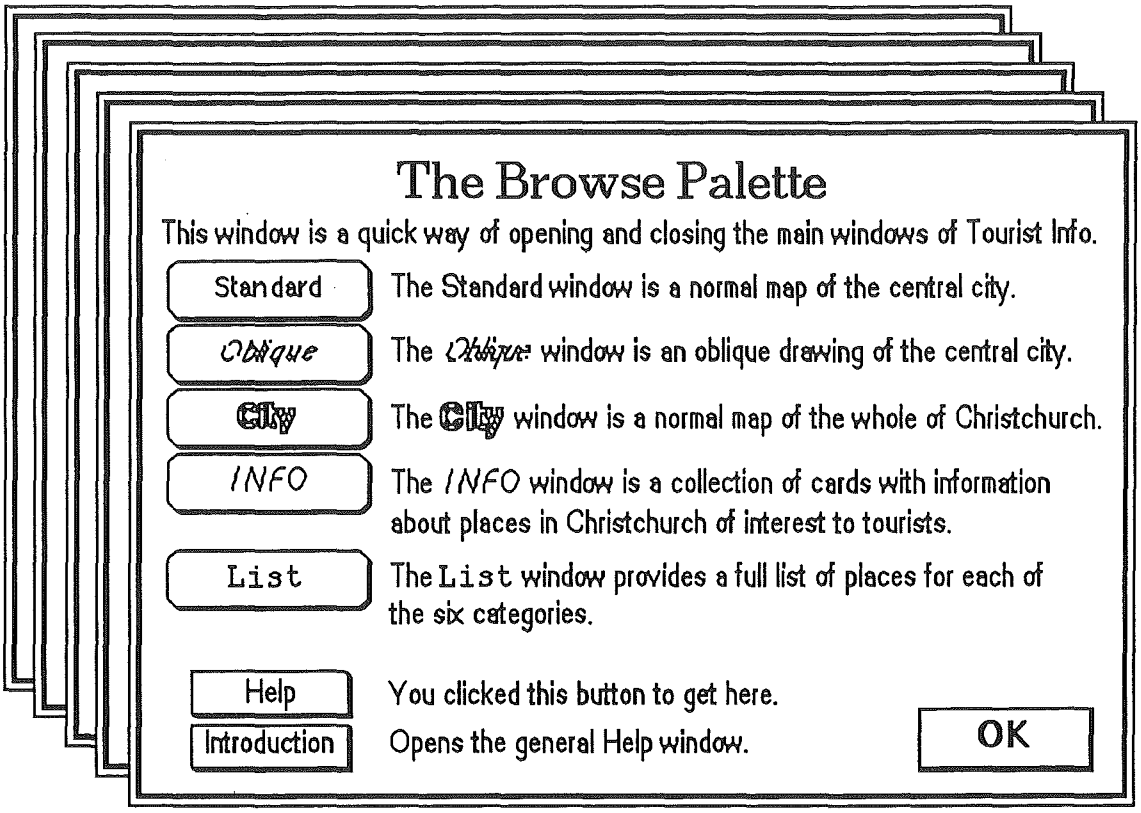


Figure 9.9. (cont'd).

User Interface

A disk is enclosed with this thesis, found in a pocket on the inside back cover (Appendix 2). It contains a compressed version of Tourist Info, which can be reviewed by any reader interested to see the user interface. What follows in this section is a summary of the major elements of this user interface. These elements are introduced by detailing two of the most common tasks attempted by users, Find Location and Enter Data. The programmed routines which drive the interface during these two tasks are found in Appendix 1.

A. Find Location

This task is attempted when the user wants to find and highlight a *facility* (a place they are looking for) on a chosen map, the name of the facility not being known exactly. The general routine for finding location is illustrated in the accompanying diagram (Figure 9.10). Each of the boxes in Figure 9.10 represents a screen presented to the user, and each is shown in more detail in the following figures (referenced on Figure 9.10).

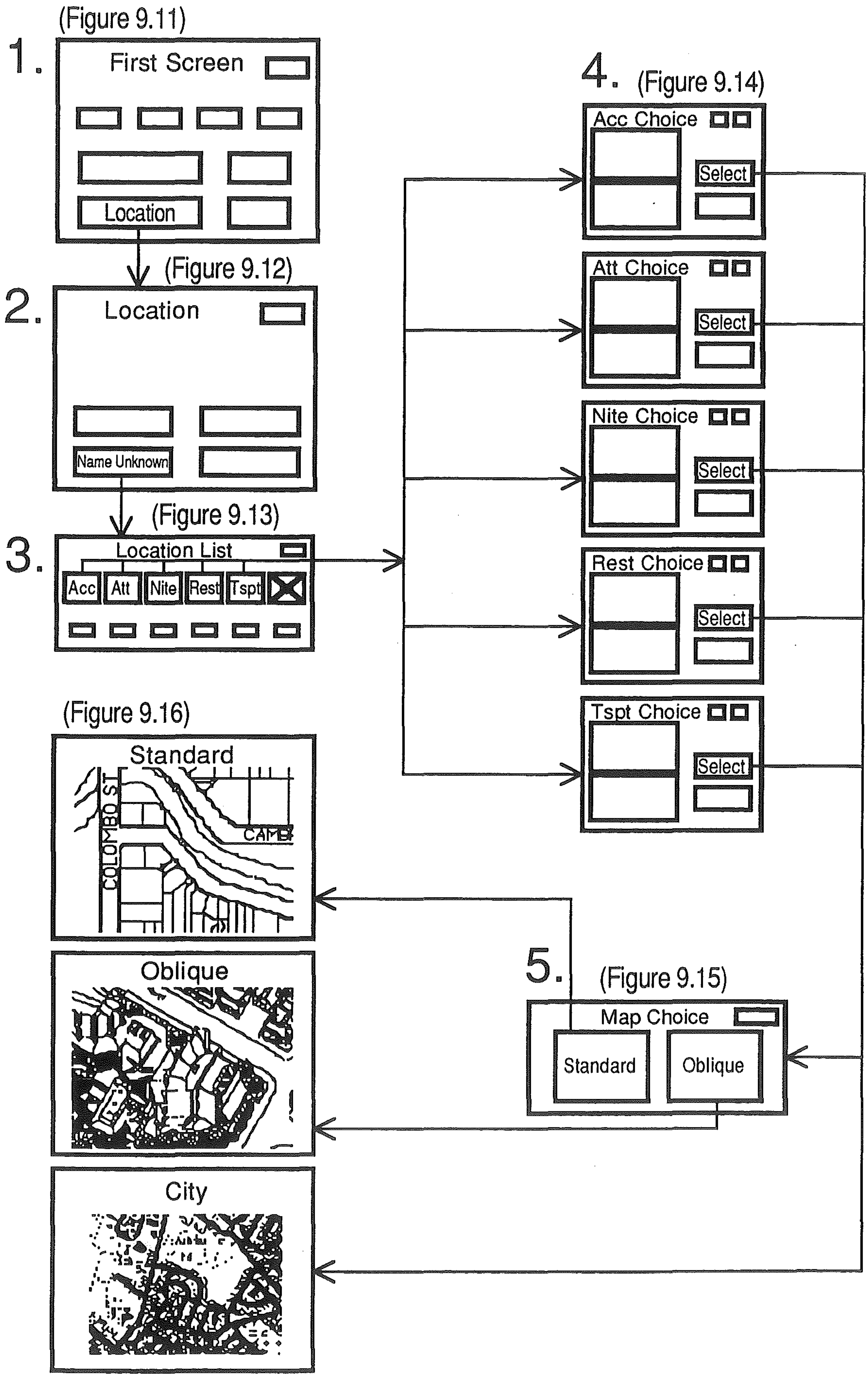


Figure 9.10. Flow chart for the 'Find Location' task, Tourist Info.

In this hypothetical case, the user is searching for 'Noahs Hotel' but can't remember the name exactly. The user must initially make four responses:

1). choose whether to find information about or location of the facility;
2). indicate whether or not the name is known exactly;
3). choose which category (of six) the facility belongs to;
4). select the name of the facility from a category list.

If the facility is in the central city, the program displays a "map choice" window, from which the user selects either the standard or oblique map to display the facility. The facility is found and displayed, therefore, by a total of five user choices.

1). The screen presented to the user is shown in Figure 9.11. The user clicks the "Location" button. The routine sends the user to the Location window, where more detailed choices can be made.

2). The screen presented to the user is shown in Figure 9.12. The user clicks the "Name not known exactly" button. The routine sends the user to the lists window, so he/she can choose which category of information his/her chosen facility is in.

3). The screen presented to the user is shown in Figure 9.13. The user clicks the "Accommodation" button. This opens a scrolling window containing all the accommodation facilities in the program.

4). The screen presented to the user is shown in Figure 9.14. The user chooses the correct name (Noahs Hotel) by clicking on that name in the list, then confirms the choice by clicking the "OK" button. The three subroutines below are automatically activated by this action

5). The screen presented to the user is shown in Figure 9.15. The user chooses one of the two map types (shown on the screen at the time of the choice) to display the facility. This routine opens the correct map and flashes the facility on and off in the colour of its category. To stop the flashing, the user clicks anywhere on the screen.

The final oblique or standard screen showing the located facility is shown in Figure 9.16.

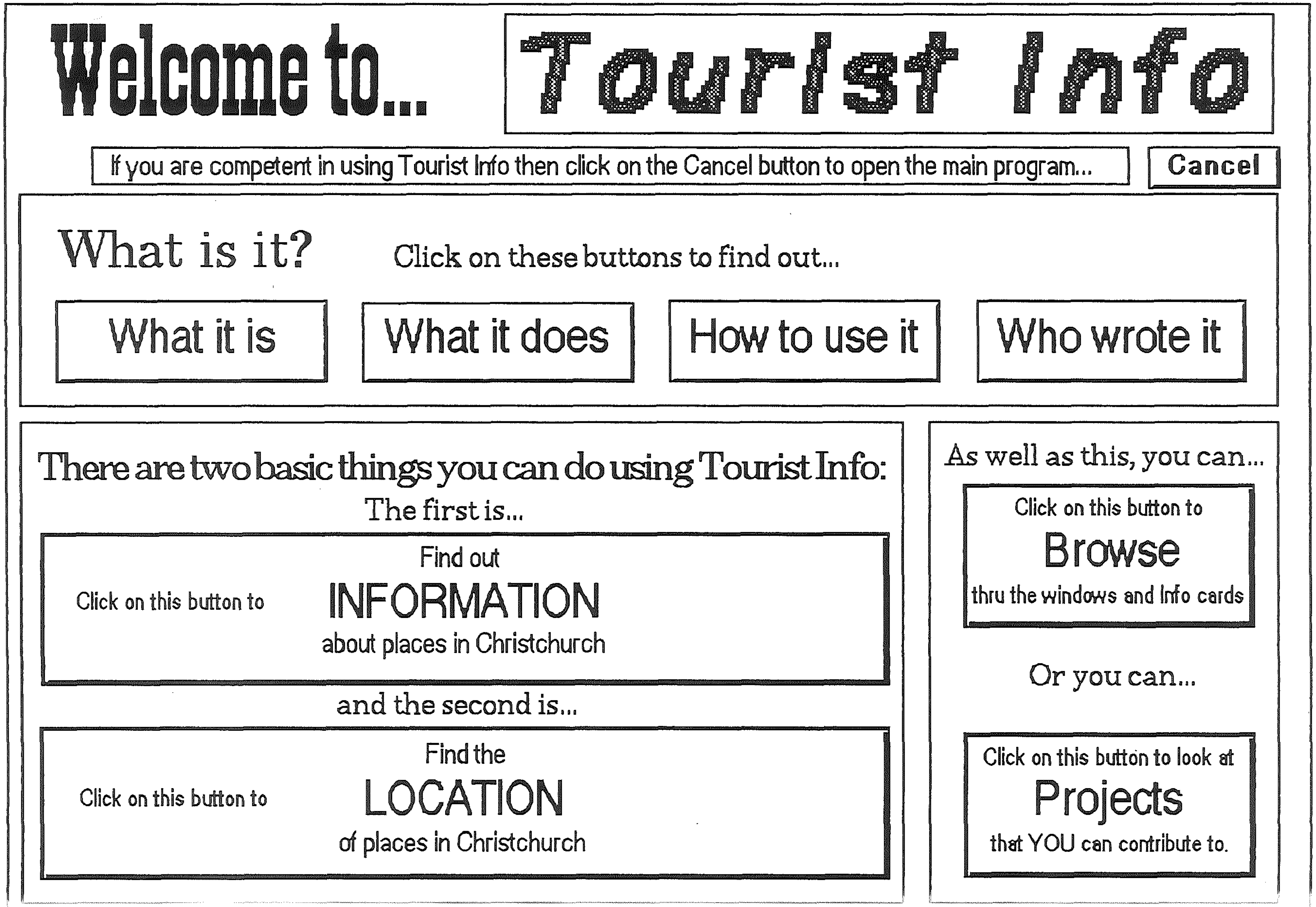


Figure 9.11. The Introduction screen for Tourist Info.

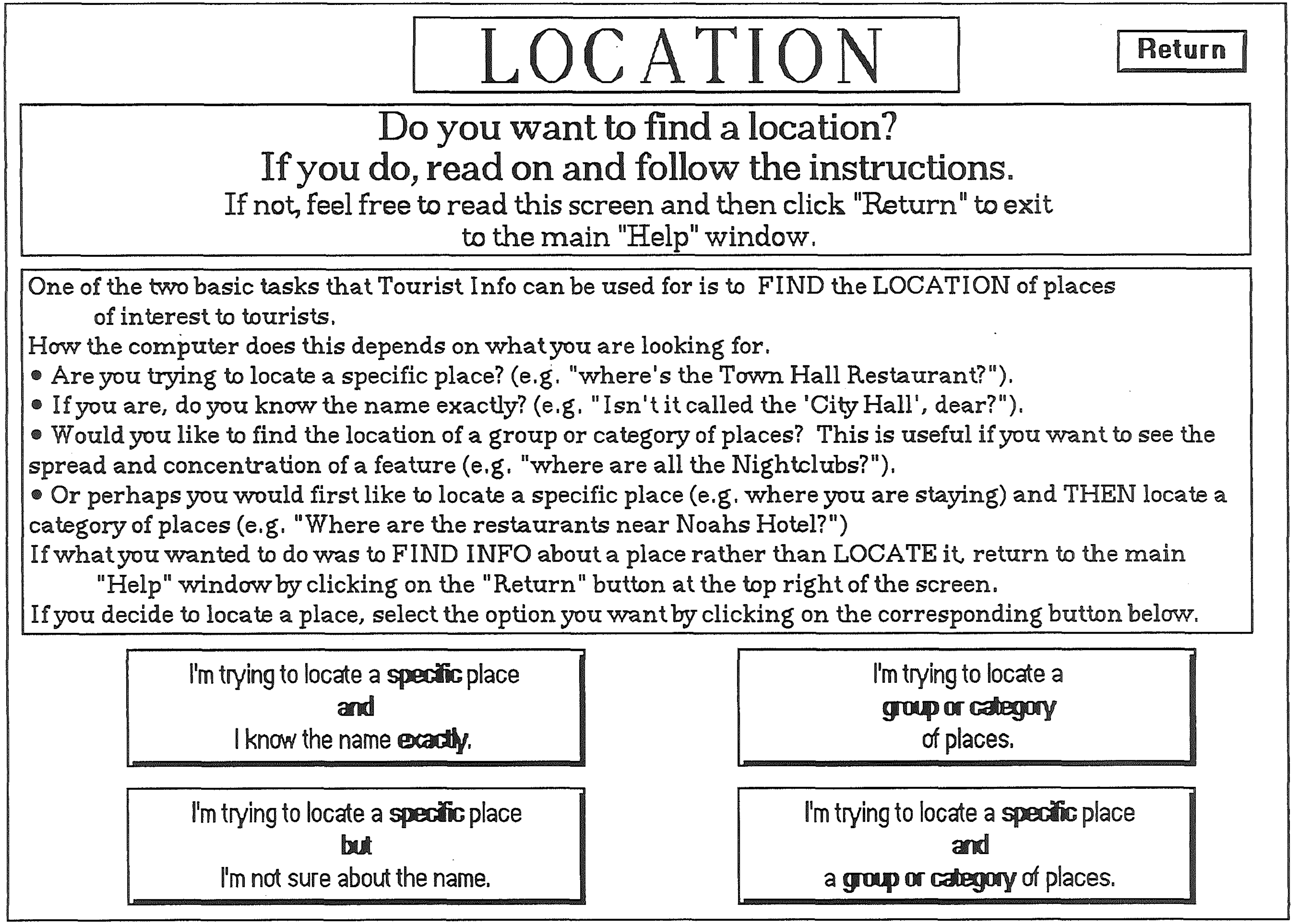


Figure 9.12. Tourist Info Location window.

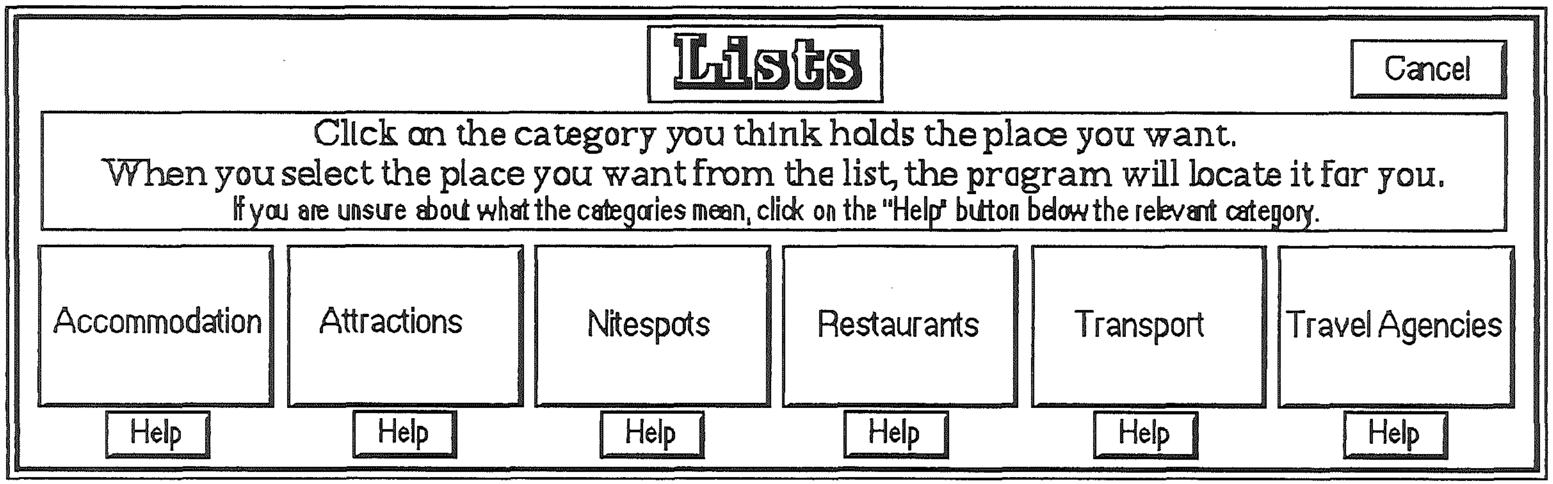


Figure 9.13. Tourist Info List Choice window.

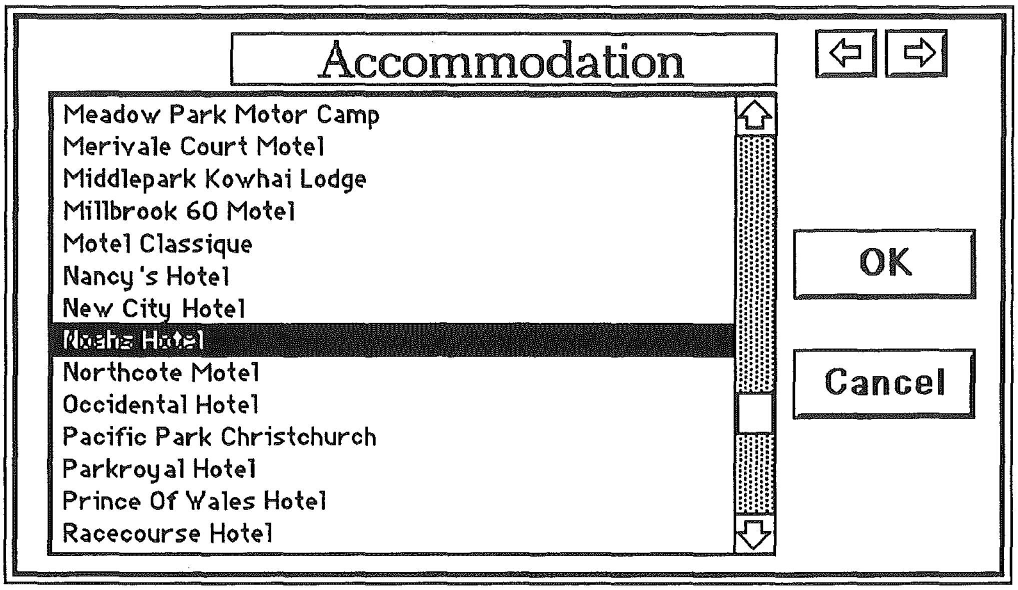


Figure 9.14. Tourist Info accommodation List window.

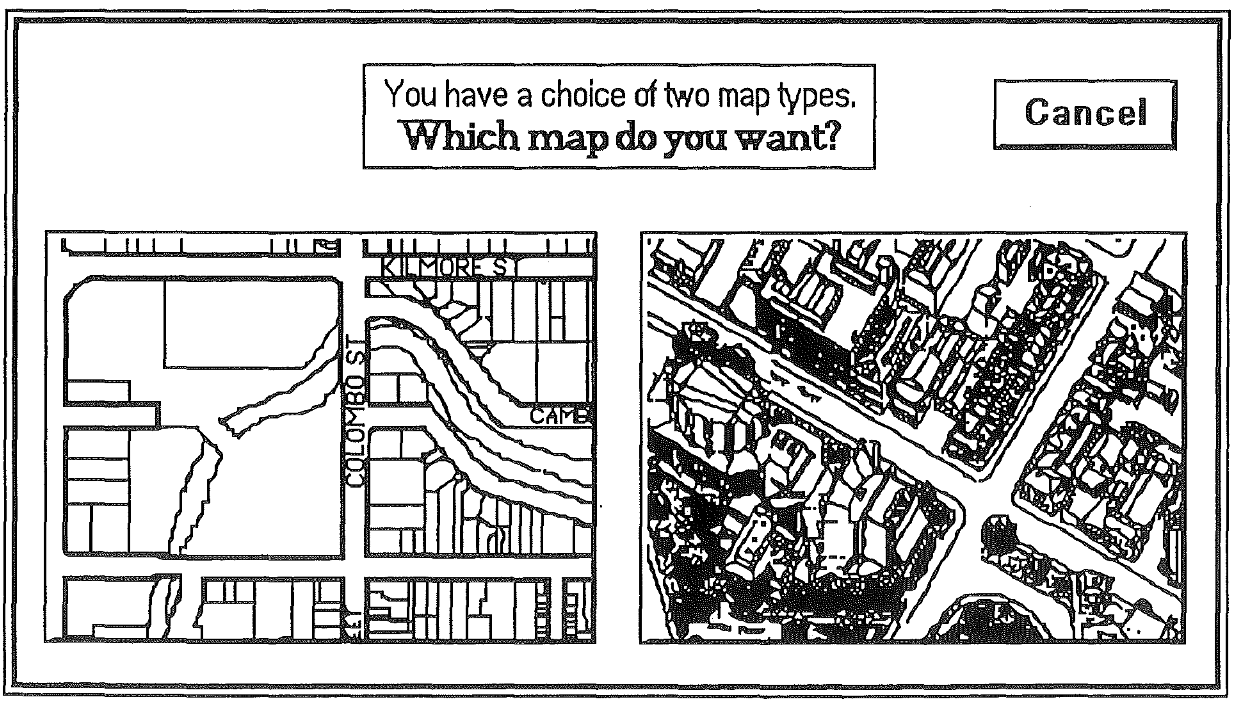
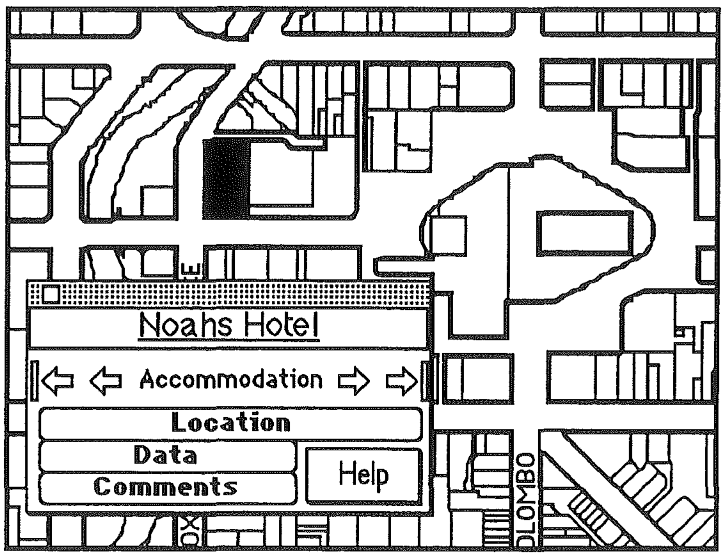


Figure 9.15. Tourist Info Map Choice dialog box.

Standard map



Oblique map

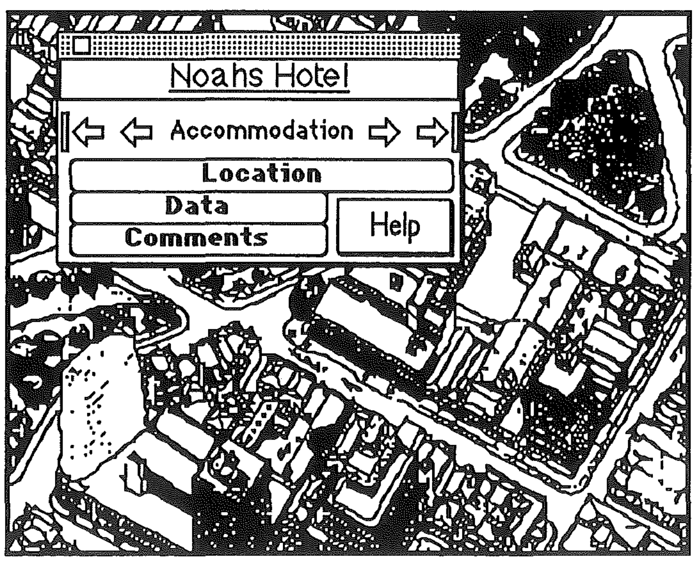


Figure 9.16. Tourist Info Standard and Oblique map extracts displaying Noahs Hotel.

B. Enter Data

This routine allows the user to enter their own data into the project. This data can be about any particular facility stored in the program. A separate place is provided for users to comment about a general category of facilities, or about the city as a whole. The general routine for entering data is illustrated in the accompanying diagram (Figure 9.17). To enter data, the user must call up the database entry of the facility about which data is to be entered. Doing this gives the user access to the database. In this hypothetical case, the user wishes to enter data about 'Chung Wah II restaurant' and remembers the name exactly. The user must make four responses:

1). choose whether to find information about or location of the facility;
2). indicate whether or not the name is known exactly;
3). type the name of the facility into the program;
4). type data into the comments space provided.

1). The screen presented to the user is the same as is shown in Figure 9.11. The user clicks the "Information" button. The routine sends the user to the Information window, where more detailed choices can be made.

2). The screen presented to the user is shown in Figure 9.18. The user clicks the "Known exactly" button. The script opens a dialog box, asking the user to type the name exactly. If the user mistypes, or if the facility is not stored in Tourist Info, an advice box is opened. Otherwise, the correct info card is found and displayed, with a place for entering data provided.

3). The screen presented to the user is shown in Figure 9.19. A second part of this script opens the correct Info card based on the user's choice.

4). The final screen presented to the user is shown in Figure 9.20. The user then enters the data.

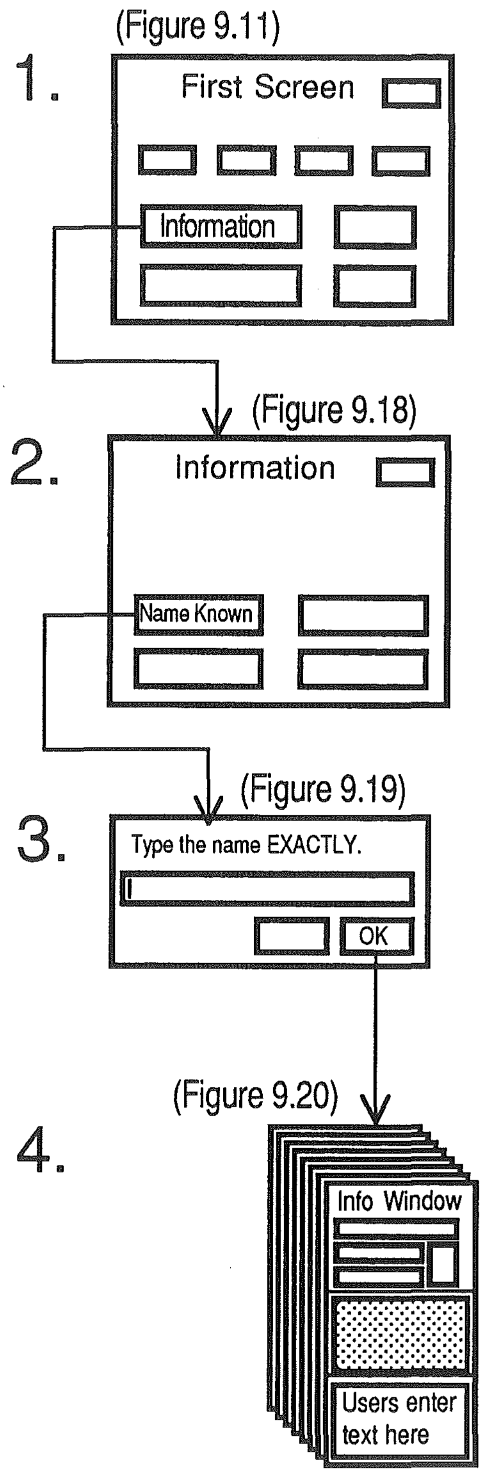


Figure 9.17. Flow chart for the 'Entering data' task, Tourist Info.

INFOrmation

Return

Do you want to find Information?
If you do, read on and follow the instructions.

If not, feel free to read this screen and then click "Return" to exit to the main "Help" window.

One of the two basic tasks that Tourist Info can be used for is to FIND INFORMATION about places of interest to tourists.

How the computer does this depends on what you are looking for.

- Are you trying to find out information about a specific place? (e.g. "what's on at the Academy Cinema").
- If you are, do you know the name exactly? (e.g. "Isn't it called the 'Academic something, dear?").
- Are you wanting to scan a whole category of places for some common information? (e.g. "Is there anything on at the pictures this week starring Harrison Ford?"). The six categories available are: 'Accommodation', 'Attractions', 'Nitespots', 'Restaurants', 'Transport' and 'Travel Agencies'.
- Or would you just like to look through all the places in a category? (maybe to do detailed comparisons).

If what you wanted to do was to LOCATE a place rather than find information about it, return to the main "Help" window by clicking on the "Return" button at the top right of the screen.

If you decide to find Info, select the option you want by clicking on the corresponding button below.

I'm searching for Info about a **specific** place **and** I know the name of that place **exactly**.

I'm scanning for a **particular** piece of Info in a **category** of places: e.g: I might want to find all the **swimming** pools in "Accommodation".

I'm searching for Info about a **specific** place **but** I'm not sure about its name.

I'd like to skim through **all** the names of places in a particular category (I might recognise some of the names).

Figure 9.18. Tourist Info Information window.

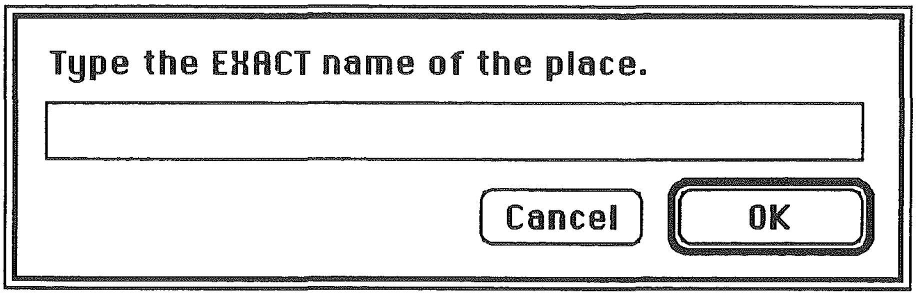


Figure 9.19. Information and Location name entry dialog box, Tourist Info.

Figure 9.20. The Info window, containing formal and informal databases, Tourist Info.

System Limitations

The Macintosh platform and the SuperCard software were chosen because they provided the author with the ability to construct an acceptable user interface in a short time span, not because they were the best tools for the generation of a full-blown UD-GIS. The limited processing power of the microcomputer and certain software limitations would restrict full development of a UD-GIS even were the time available for such development.

Hardware limitations

The computer's 68030 processor took some time to display bit-mapped graphics and colour screens, but the wait (measured in seconds) for user-chosen tasks to be completed attracted no adverse comment. However, there was no mathematical computation done in this program: had the tasks involved interactive projection transformation, as was mooted in Chapter Eight, the waiting time would have been much longer, in all likelihood intolerable to many users.

An obvious technological and logistical limitation related to the use of any computer is portability. People who use a paper map for navigation can carry it about in their pocket. However, a computer of the power required to run Tourist Info is in no way portable. This problem could have been solved by the addition to the system of a printer to produce hard copy of people's maps, but this solution was expensive and would still have required users to return to a central point for a second enquiry.

Software limitations

A more serious development problem was an undocumented apparent limitation on the number of hot spots per map. Each hot spot was made up of a button and a graphic laid over a bit-mapped image, as shown in Figure 9.21. Because each button contained a small script describing its unique attributes, and each graphic was in colour, each hot spot took up a considerable amount of memory (about 1.5 - 3 kilobytes). With over 500 hot spots possible on a map, the bit-mapped image of which might itself be 600 kilobytes, each map could theoretically be up to 2000 kilobytes (2 megabytes or 2mb) in size. Even though the machine was equipped with 5mb of RAM - memory in which the program stored the image while processing it - the program could not manage to load such large images. Even though only part of the map would have been on-screen at any one time, the rest of the image was buffered in memory, placing stress on the program's memory management. The result was a series of 'meltdowns' in which the whole image became corrupted and these proved to be unrecoverable. Seemingly, the program could handle a maximum of about 200 - 250 hot spots per map.

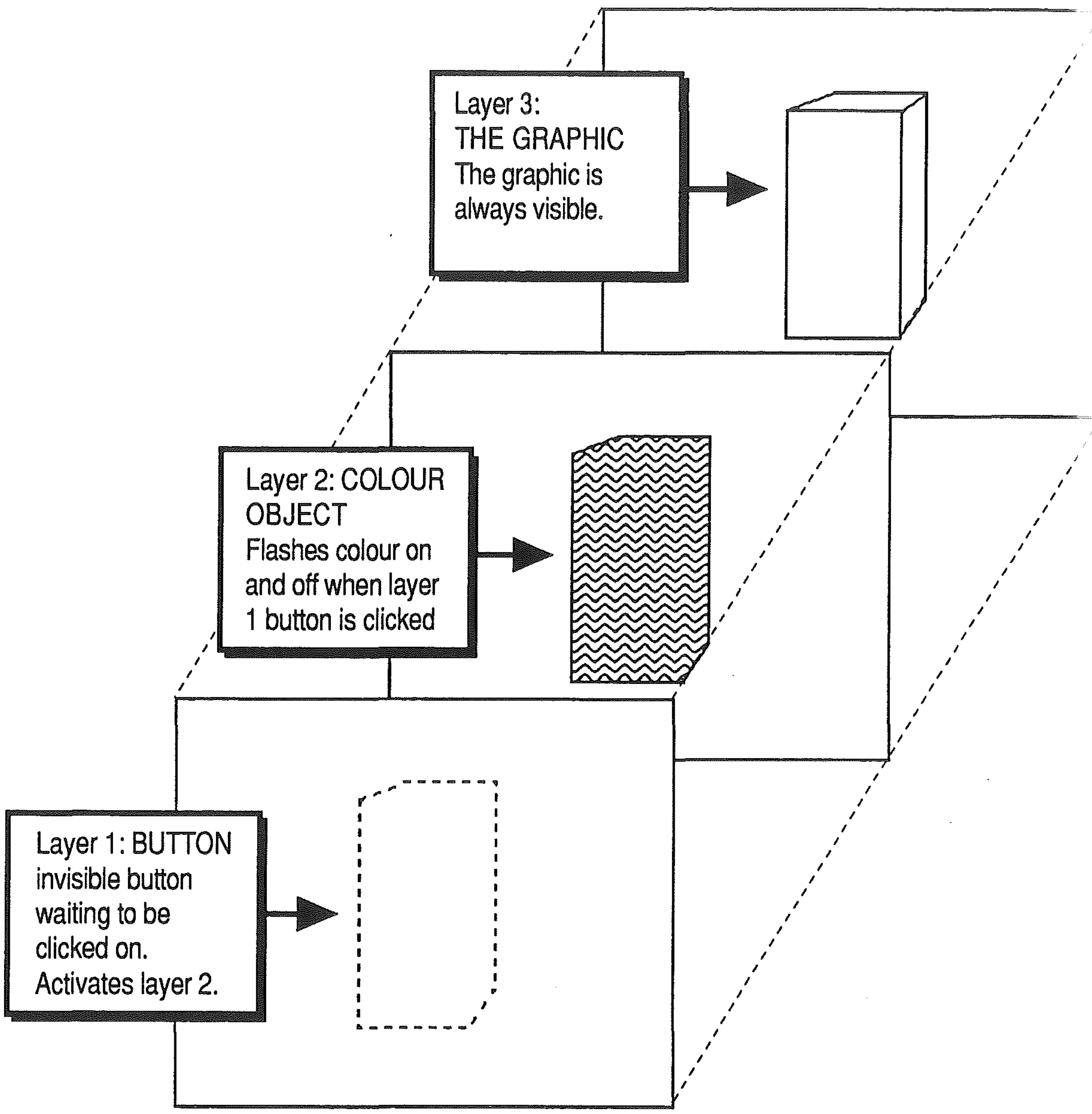


Figure 9.21. 'Hot Spot' design, Tourist Info.

Limitations to conceptual design

The concept of Tourist Info as a test of map preference was compromised to an extent because of this serious software limitation. It was found necessary to split up the city-wide and the oblique map, both of which would have been complex images up to A1 size. The City map was divided into four maps (NW, NE, SW and SE: Figure 9.22.), while the Oblique map was reduced in size by 50% from the original and divided into four maps (Figure 9.23.). This made the program somewhat more complex, with new seek routines required to note which of the four maps to open, users having to choose which of four maps to look at and having to navigate between them.

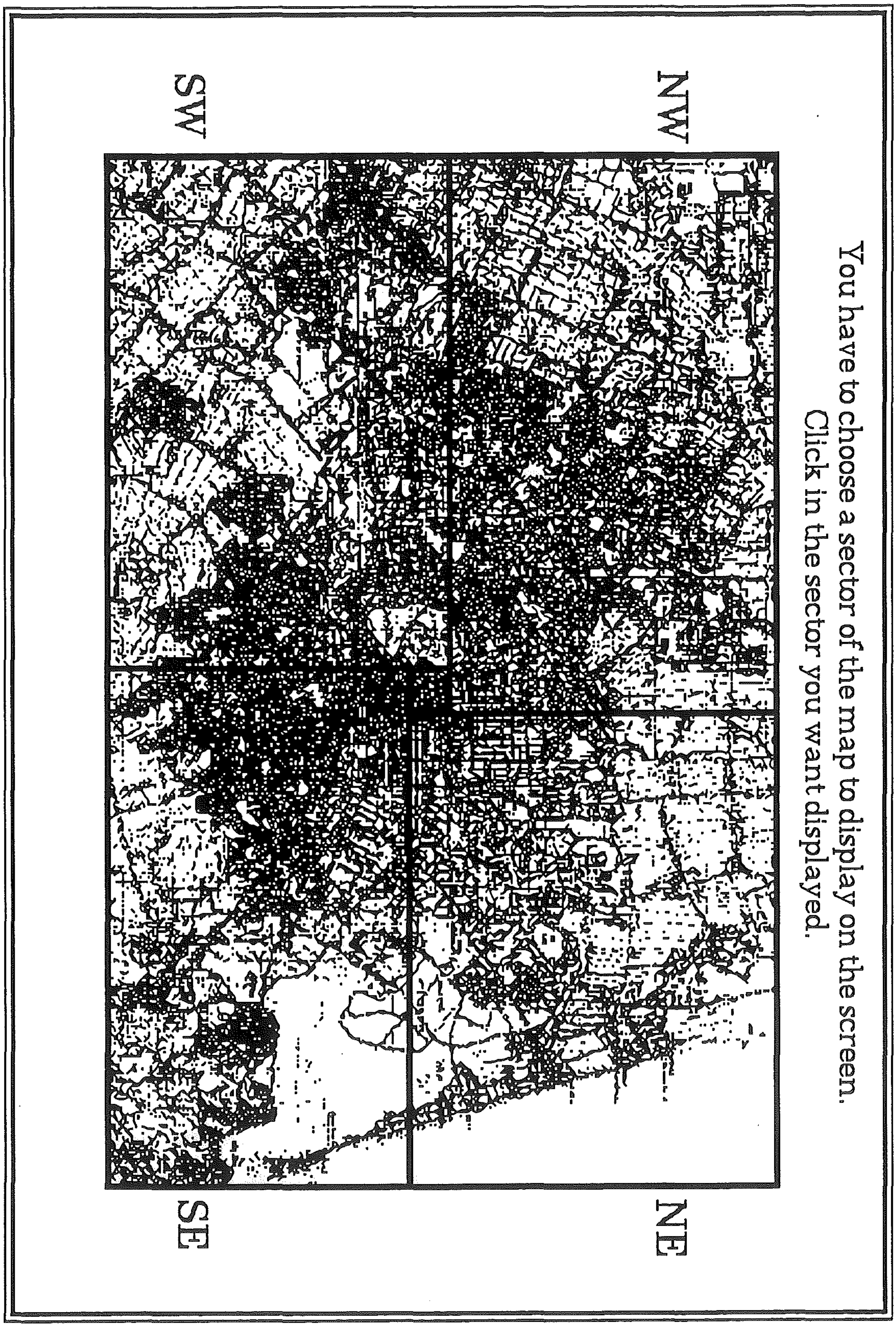


Figure 9.22. City Map choice window, Tourist Info.

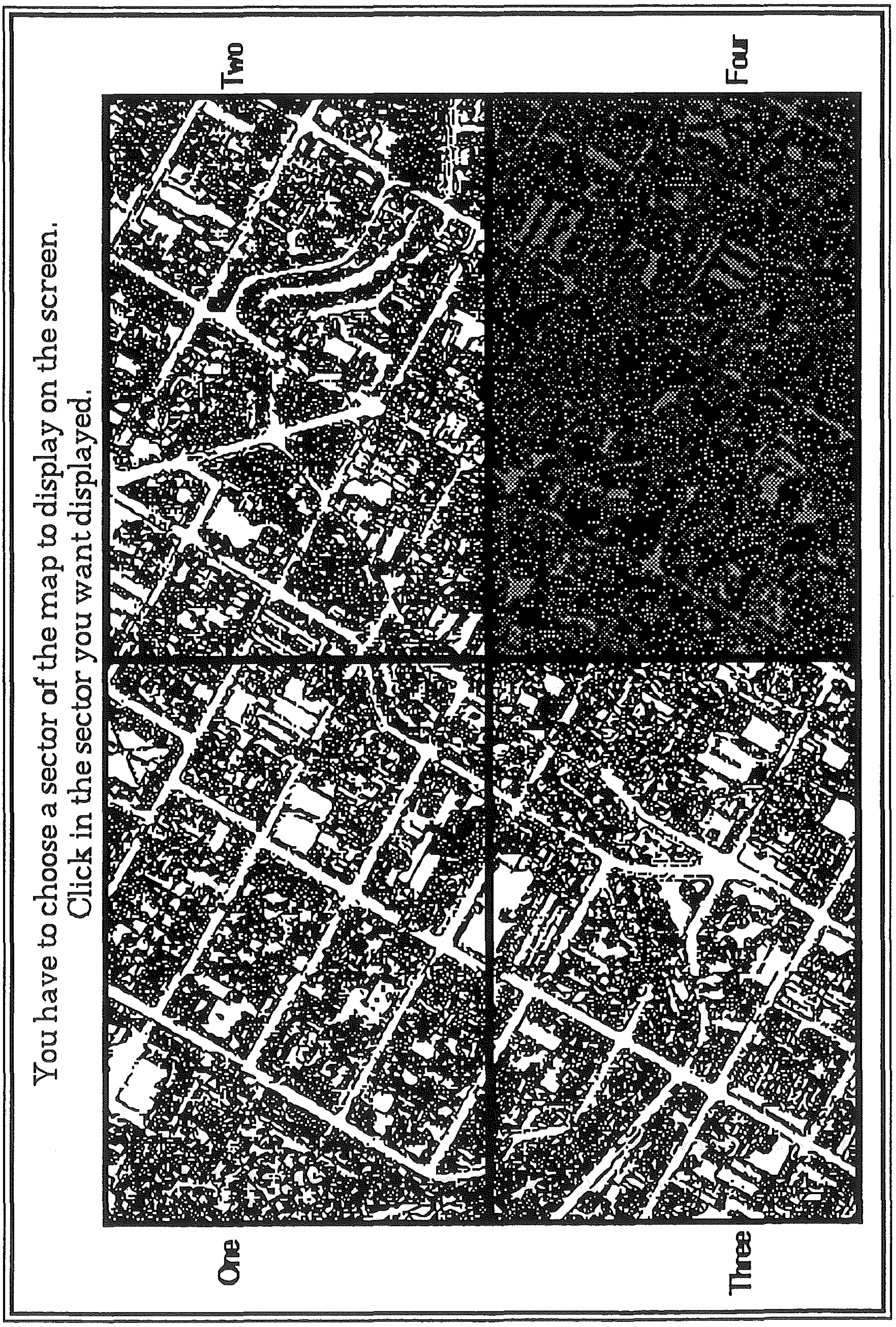


Figure 9.23. Oblique Map choice window, Tourist Info.

The nature of the problem meant that it did not arise until late in the development, when the final hot spots were being installed, and so little modification was possible to the overall conception of the program. What this meant was that, in the mind of the present author at least, *the oblique maps covered an unacceptably small area of the inner city.* It was thought that these maps would prove less than useful in city-wide navigational tasks, especially when compared with the one standard map which covered the whole central city. This appeared, before testing, to introduce a bias towards the standard map.

The Testing of Tourist Info

The Testing Procedure

This section outlines the factors tested in the public demonstration of Tourist Info, how the testing was carried out, and where and when it was tested. The results of this testing, and discussion of those results in the context of this thesis, appear in subsequent sections.

Three major aspects of user interaction with the system were specifically examined. These are:

1): User Profile.

- Who the users of a UD-GIS are likely to be (by age, gender, origin and familiarity with computers).

2): User Reaction to system.

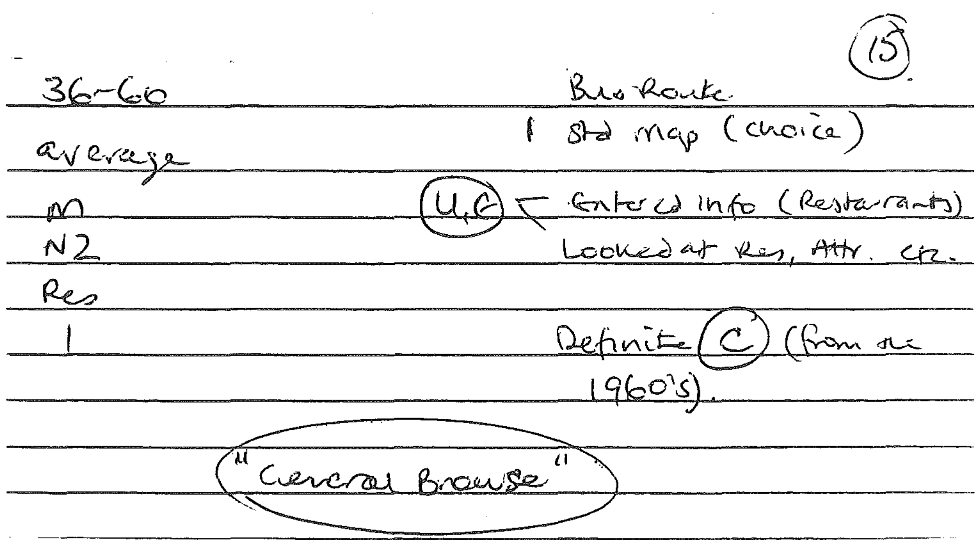
- The extent to which unsolicited users will use such a system;
- The types of qualitative user reaction both to the machine and the program;
- What data are of interest to these users;
- What sort of maps are favoured by users to display their data;

3): User Modification of system.

- The amount and diversity of input that users are prepared to contribute;
- Whether users suggest improvements in form and content;
- The extent to which the system needs to be modified;
- The extent to which the system *can* be modified; and
- The number of iterations needed to produce a satisfactory outcome.

Rather than invite a sample of potential users to be involved in a test (whether in the laboratory or on their own territory), the testing was to be conducted in a manner as closely approximating the real working conditions of the system as possible. This meant that potential users were not to be solicited, with the greatest degree of enticement to use the system being the presence of the system itself in a tourist environment and an accompanying written explanation of its function. That is, the ostention of the communication was to be limited to that of the system, not allowing the needs of the researcher to become more important than the needs of the user. It was anticipated that the policy of non-solicitation would mean that fewer people would be included in the database, but this was accepted as making the exercise more credible.

At an appropriate moment in the session each user was informed that the aggregated results were part of a Ph.D. study on the way people use maps. The suggestion that both the user and the operator were getting something from the exercise was well received by all users. Three methods were used to capture information. (1). The author recorded a number of user responses on small cards (Figure 9.24.), mostly qualitative interactions like evidence of user diffidence or pleasure in using the system, and comments on the system by users. (2). While people used the program a data logger kept count of the various choices made (Figure 9.25.) when users selected particular actions. In this way the author could determine which aspects of the system were used most often and by whom. (3). At the end of each session, users were asked to enter statistical information about themselves (Figure 9.26.). The combination of these three data sources allowed both a user profile and a use profile to be built up, which could later be inter-related for meaningful analysis.


15

36-60	Bus Route
average	1 Std map (choice)
M	U,C ← Entered info (Restaurants)
N2	Looked at Res, Attr. etc.
Res	
1	Definite C (from the
	1960's).
"General Browse"	

Figure 9.24. User response record cards for Tourist Info.

Reset

Counter Fields for PhD Assessment

LIST: Info	
Accommodation	8
Attractions	71
Nitespots	28
Restaurants	55
Transport	3
Travel Agencies	2
TOTAL	167

LIST: Location	
Accommodation	6
Attractions	19
Nitespots	9
Restaurants	23
Transport	1
Travel Agencies	0
TOTAL	58

Maps opened: TOTAL	
City	33
Standard	43
Oblique	49
TOTAL	125

Maps opened: CHOICE	
Standard	23
Oblique	34
TOTAL	57

Task Chosen	
TOTAL INFO	97
Specific Place, name known exactly	4
Specific Place, name not known	46
Find word in a category	47
Skim through categories	0
TOTAL LOCATION	17
Specific Place, name known exactly	5
Specific Place, name not known	5
A category of places	7
Specific place and a category	0
TASK TOTAL	114

Figure 9.25. Tourist Info data logger.

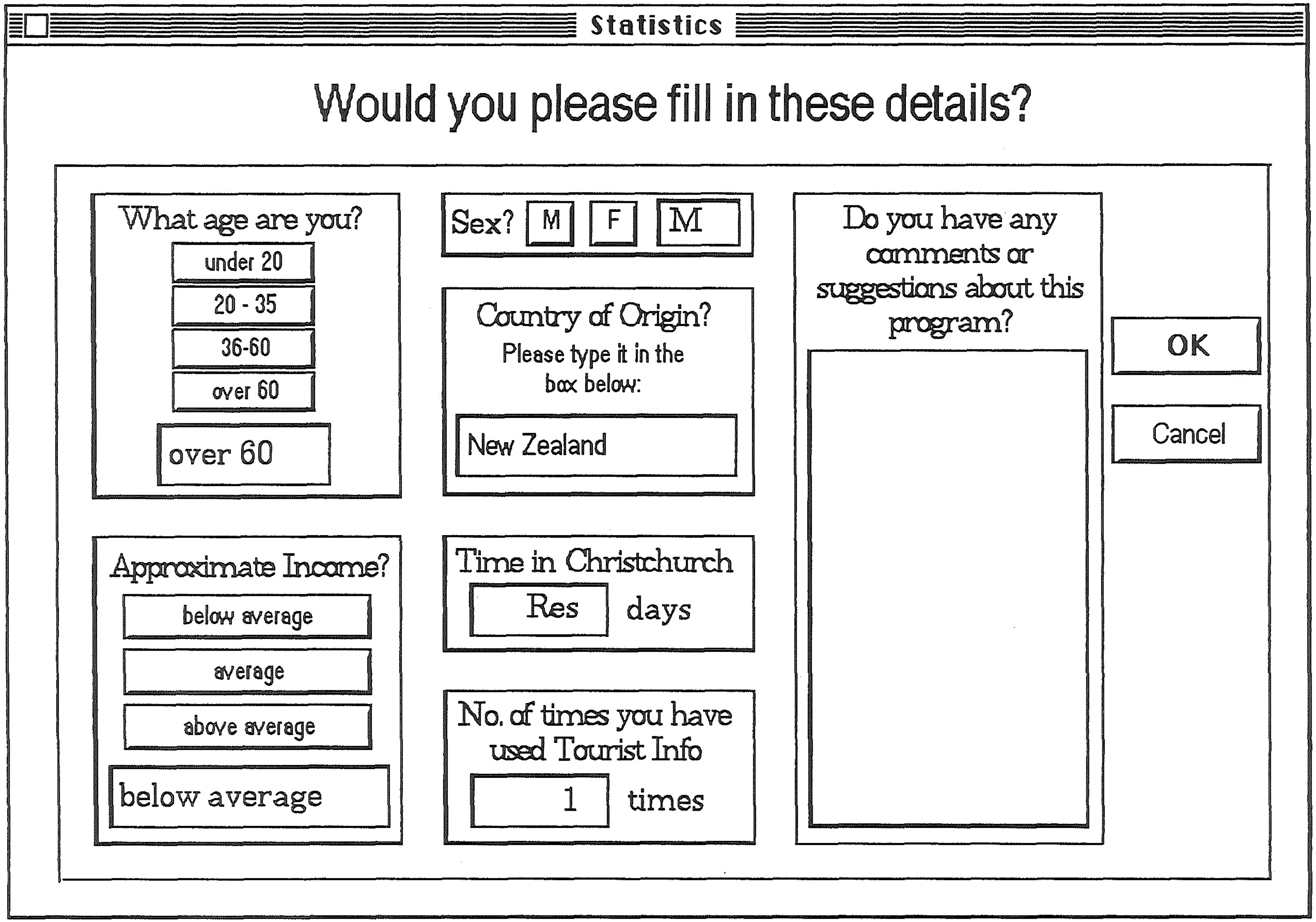


Figure 9.26. Tourist Info statistics window.

An initial site was chosen for a two-week trial period beginning August 3rd, 1990. The system was set up at the Youth Hostel Association's building in central Christchurch, the location of which is shown in Figure 9.27. It operated a total of six evenings during the two week period, being available to potential users for 18 hours. During this time 10 different people used the system, one using it twice, for a total of 11 uses. This is less than one use each hour.

It was felt that this was a poor response rate, in spite of the fact that people used the system for an average of fifteen minutes. A number of factors contributed to this low response rate. Most importantly, the system was located in a low-traffic area within the building. A large banner behind the system was visible to an average of about eight to twelve people during an evening. This can be contrasted to the main reception area, which saw at least one hundred people during the evening. The lounge led nowhere, while many people passed through the reception area. Moreover, people came to the lounge area to relax, certainly not a frame of mind in which to tackle what to some was a daunting computer system. Associated with this factor was the large number of information sources in the building. As well as the main reception itself, staffed almost continuously, there were two notice boards and a pamphlet rack in the reception area. The lounge had another notice board and pamphlet rack. While the operator was not free to count precisely, it was his observation that the sources of information in the reception area were heavily patronised. A potential user had to pass five other sources of tourist information before arriving at Tourist Info.

The author sought unsuccessfully to site the system in the main reception area: apparently fire regulations forbade the granting of such a request. The trial period ended with the termination of the Youth Hostel as a site for testing.

Across the road from the Youth Hostel is Canterbury Museum. Late in August the directors of the Museum granted permission for Tourist Info to be sited in the newly-redesigned main foyer of the building. Almost all of the hundreds of visitors each day pass through this foyer twice during their time at the Museum, and response rates were expected to be higher than at the Youth Hostel. Testing began on the 10th of September and ran for two weeks. During this time the system was in operation five hours per day (9am - 12pm and 2pm - 4pm), with a break of one day (Monday 17th September), for a total of 65 hours. 58 people used the system during this time, one of whom used it twice, the total sessions being 59.

The usage statistics are therefore as follows: *the system was operational for 83 hours and saw 68 people use it for 70 sessions.* This represents .84 sessions per hour. Not included in these figures are an undetermined number of onlookers: in one case, a whole school party watched one of their number use the system.

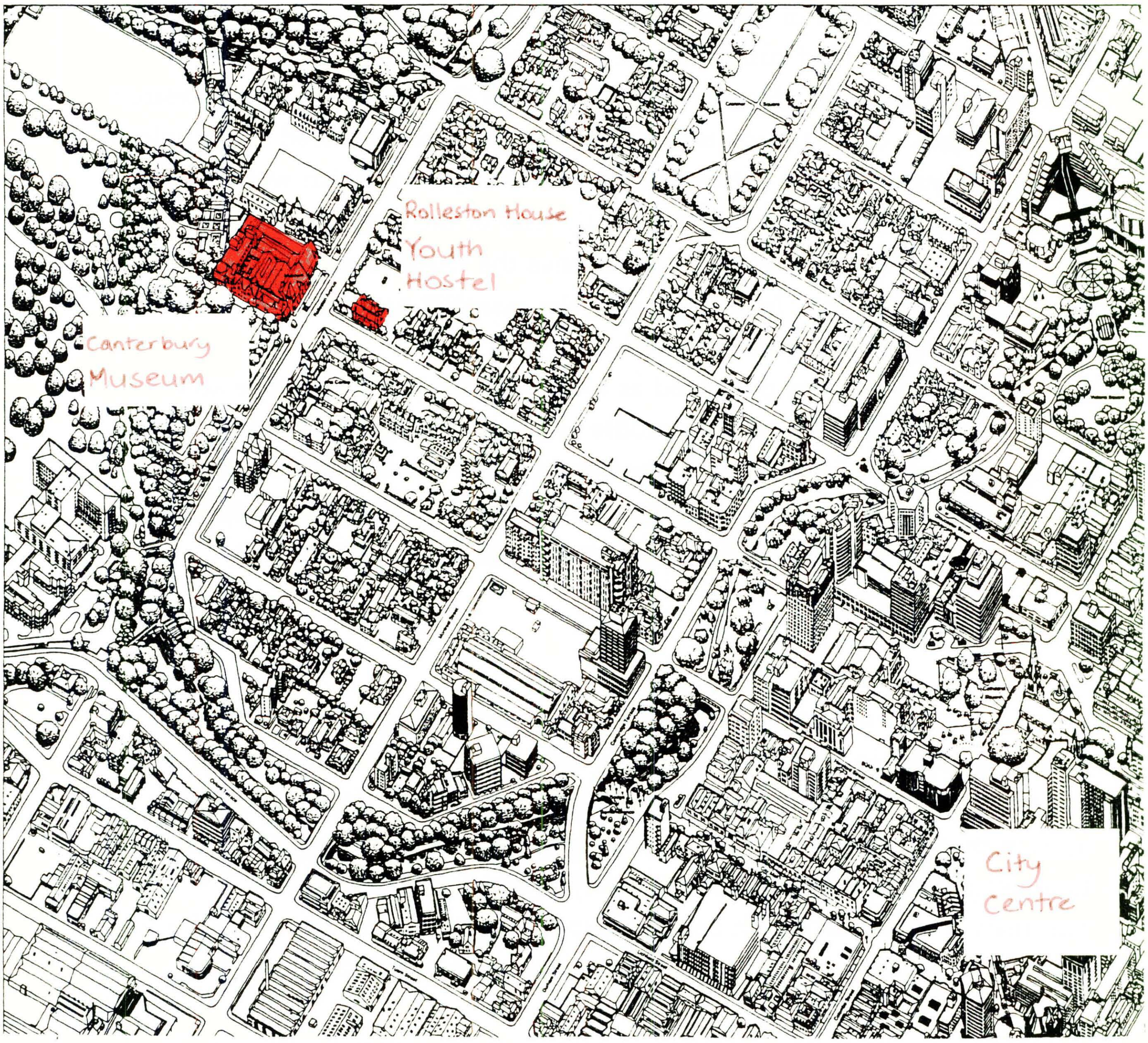


Figure 9.27. The location of testing sites for Tourist Info.

Results

It must be said at the outset that the quantitative results of this testing are an order of magnitude too small for meaningful statistical analysis. Because of the large number of variables tested, numbers in cross-tabulation tables are often in single figures. Approximately 500 randomly sampled sessions taking a total of 600 hours over 100 days would have been required to generate numbers of sufficient size to create statistically-defined confidence in the data. However, confidence of that level was never desired in this project. Indeed, such testing would have been rendered meaningless by the constant iteration between users and the system which would have resulted in a quite different product at the end of the testing than at the beginning. Such an occurrence contravenes the requirements of a controlled experiment. In other words, the essential nature of the project is not best assessed by statistical analysis.

Instead, results are presented as a combination of quantitative and qualitative assessments. A user profile and a use profile are complemented by the comments of the users themselves and the observations of the author. These results lead to discussion rather than conclusions, pointing to areas of research interest rather than making definitive statements.

User Profile

Table 9.1 is a summary of the profile of users of Tourist Info. The difference between the two parts of the table is simply that 68 different people had a total of 70 sessions with the system. The number of sessions is used in preference to the number of people, because in both cases of second-time use the use profile was significantly different to the first use. For purposes of cross-tabulation between aspects of the user and use profiles, the number of sessions is a more relevant measure of user interest in the system.

It is recognised that a random sample of users was not achieved. In fact, this was not the goal of the testing procedure. The generation of a random sample requires, paradoxically, a great deal of planning, intervention and selection on the part of the researcher, a level of control far beyond what was considered desirable in this case. The decision not to solicit or select a random sample meant that a certain bias towards those undaunted by computers was anticipated: it was one of the goals of the project to see whether this system would be particularly susceptible to this bias. Forcing a random sample to take part in the research would have destroyed the chance of comparison between Tourist Info and many of the maps critically reviewed in this thesis.

User Profile	**68 Users**	**70 Sessions**
Age		
<20	9	9
20-35	31	32
36-60	19	19
60+	9	10
Income		
Below Average	21	22
Average	31	31
Above Average	16	17
Gender		
Male	44	45
Female	24	25
Origin		
Tourist	26	27
Local	42	43
Computer Literacy		
Literate	36	37
Illiterate	32	33

Table 9.1. User Profile of Tourist Info.

The important aspects of the user profile are: the sample is somewhat *younger*, has a perceived *lower income*, is predominantly *male* and is more *computer literate* than would be likely from a random sample of the population over ten years of age.

- Age (Table 9.2.).

Age sessions					
YHA	11	MUS	59	TOT	70
<20	1	<20	8	<20	9
20-35	9	20-35	23	20-35	32
36-60	0	36-60	19	36-60	19
60+	1	60+	9	60+	10

Table 9.2. Ages of the sample from YHA, Museum and Total.

The Youth Hostel site has an obvious bias towards the 20-35 age group which is reflected in the user profile. It was expected that the Museum site would balance this. This happened to some extent, but even in the Museum over half of all users were under 36 years of age. An analysis of age by gender (Table 9.3.) suggests that the male population of the sample was somewhat younger than the female population.

X Age	Gender sessions Male	Female	Ratio
<20	6	3	2.0 to 1
20-35	22	10	2.2 to 1
36-60	12	7	1.7 to 1
60+	5	5	1.0 to 1

Table 9.3. Age by Gender cross-tabulation.

- Income (Table 9.4.).

Income sessions					
YHA	11	MUS	59	TOT	70
Below	5	Below	17	<20	22
Avge	4	Avge	27	Avge	31
Above	2	Above	15	Above	17

Table 9.4. Incomes of the sample from YHA, Museum and Total.

Users were asked to state whether they considered their income below average, average or above average. User self-perception is that the group is slightly below average in income, figures certainly within the bounds of statistical error. When income is correlated with age (Table 9.5.) it can be seen that younger people in the sample perceive themselves to be less well off than older people.

X Income	Age <20	sessions 20-35	35-60	60+
Below	8	11	2	1
Avge	0	16	11	4
Above	1	5	6	5

Table 9.5. Income by Age cross-tabulation.

- Gender (Table 9.6.).

Gender sessions					
YHA	11	MUS	59	TOT	70
Male	10	Male	35	Male	45
Female	1	Female	24	Female	25

Table 9.6. Gender of the sample from YHA, Museum and Total.

Almost twice as many men as women took part in the project. This is influenced somewhat by the session procedure: when more than one person approached the system (such as a couple), only one of the two or more people were recorded. This was done because the internal data logger could not tell if more than one person per session used the machine. The choice of which user to obtain statistics from was made subjectively by the operator on the basis of whom he judged had been the main interagent with the system. It is distinctly possible that his own biases (indeed, his gender alone, perhaps) may have influenced the record towards a greater number of male participants.

- Origin (Table 9.7.).

Origin sessions					
YHA	11	MUS	59	TOT	70
Tourist	10	Tourist	17	Tourist	27
Local	1	Local	42	Local	43

Table 9.7. Origin of the sample from YHA, Museum and Total.

Significantly, many more locals than tourists used the system, with a ratio of locals to tourists of more than 3:2. This was particularly evident at Canterbury Museum, where the ratio was more in the order of 5:2. This was unexpected, particularly given the signs accompanying the project which proclaimed it as of relevance to tourists.

- Computer Literacy (Table 9.8.).

Literacy sessions					
YHA	11	MUS	59	TOT	70
Literate	7	Literate	30	Literate	37
Illiterate	4	Illiterate	29	Illiterate	33

Table 9.8. Literacy of the sample from YHA, Museum and Total.

Over half of all participants professed at least some familiarity with computers. This is judged to be much higher than would be expected in a random sample, but was anticipated in a project of this nature. That anyone unfamiliar with computers was able to use the system is gratifying, these 32 people themselves being perhaps the single most important piece of evidence in testimony to the success of the system. However, of the 36 people familiar with some form of computer, only eight had used a Macintosh before. 62 of the 70 sessions involved people who were having their first encounter with this platform.

X Literacy	Age <20	sessions 20-35	35-60	60+
Literate	8	19	10	0
Illiterate	1	13	9	10

Table 9.9. Literacy by Age cross-tabulation.

Table 9.9. shows computer literacy assessed by age. It is apparent that young people are more likely to be computer literate than are older people, with proportions reversed for the under 20 and over 60 age groups. This was anticipated, as young people have increasingly been exposed to new technologies both at school and in the workplace. What was not expected was the finding that computer literacy in this sample is also influenced by gender (Table 9.10.): a greater proportion of males than females are computer literate.

X Literacy	Gender Male	sessions Female	Ratio
Literate	26	11	2.4 to 1
Illiterate	19	14	1.4 to 1

Table 9.10 Literacy by Gender cross-tabulation.

- Race.

It should finally be noted that, although no record was kept of the racial background of users, the author noted that none of the 68 users were Maori or Polynesian. The closest such people approached the system was as part of a group of onlookers. It is likely that those of minority racial backgrounds are under-represented in Youth Hostels and museums.

The author can add to this profile by offering his own observations and the comments by the users themselves. The male dominance of the use of the system is emphasised by these observations and comments. Men appeared to be more confident than women while using the system: in one case, a male visitor to the Museum began to use the system while the operator was briefly in another part of the foyer. The other extreme was represented by a young woman who appeared frightened of the computer, and kept repeating "I just want information on Thai restaurants. You make the thing work." Often, when a male-female couple approached the computer, the male would sit down and use the system even though it may have been the female who made the initial inquiry. Finally, the four most highly qualified computer users who completed a session with the UD-GIS were all men: a British GIS researcher, a local computer systems analyst, a man who worked at the computer research lab for Hughes aircraft in the USA, and a man who owned a computer consultancy business. The most experienced female computer user in the sample was a young woman from Lincoln University's Parks and Recreation Department who owned her own Macintosh.

Tourists were much less likely to sit down and play with the machine themselves, almost always asking the operator to work the computer for them. Locals, on the other hand, seemed to expect to be allowed to use the machine. The reluctance by tourists to participate directly was also noticed in older people, who were often hesitant about entering comments into the system. Young children were the opposite, rushing over and asking "Has it got any games?" and wanting to explore the program without having to know what it was. As he entered the foyer one boy's face lit up and he whispered "Computer, computer" in a reverent manner as he approached the machine. Teachers spoke sternly to their children outside the foyer in an attempt to regiment their charges, but invariably some (almost always boys) would break ranks upon entering the foyer and crowd around the computer.

The author was pleasantly surprised by the length of time many people were prepared to spend interacting with the program. The experience of A Geographer's Guide to Dunedin, where the average session length was three minutes, had conditioned expectations. However, some people actually spent more time exploring the UD-GIS than they did the rest of the Museum.

The significance of this user profile is that it indicates what type of people are more likely to use a UD-GIS. Younger, computer-literate, European-descended males are the group most represented in the sample obtained by testing Tourist Info. This pattern reflects (but does not necessarily confirm) the contentions of feminist writers such as Gribben (1984), who see the design of, instruction about, access to and application of computer technology "as part of the male appropriation of resources" (Chalmers and Forer, 1987: 152).

By implication, therefore, many potential users of a UD-GIS are in some way prevented from using such a system. Older people are uncomfortable with computer technology, and those who did use the system insisted that the operator do the input for them and interpret the results. In two cases the operator conducted impromptu introductory computer courses for groups of interested retired people, one such happening lasting almost an hour. In spite of this careful and gentle initiation to the technology, only one or two of the group were willing to try the program. Most remained daunted by the jargon of computerspeak, with mice that clicked, rectangular buttons and swiftly changing screens.

Women were more reluctant to use the system. As mentioned above, other factors might account for some of this reluctance. However, the pattern of higher male usage of an enabling technology echoes conditions in society as a whole, in which women come to expect a peripheral place in public space. Less access to advanced education and job opportunities involving computer use may contribute to the higher computer illiteracy of women and the non-participation of minority racial groups. No matter how all-embracing a piece of software or a map purports to be, it is of little use to its intended audience if the medium it is presented by is intimidating to them.

Use Profile

Table 9.11. is a comprehensive summary of the type of uses to which Tourist Info was put. It includes data from both the program's data logger and the observations of the operator.

The important aspects of the use profile are:

- the system was used equally for general browsing and specific inquiries
- most people used the formal and informal database
- over a third of users entered informal data
- the oblique map was used more than any other map
- the oblique map was preferred by choice over the standard map (when a facility could be displayed in either)
- the two procedural maps (Oblique and Bus Routes) attracted the same amount of use as the two planimetric maps (City and Standard)

Use Profile (number of uses)	
Inquiry Type	70
General	34
Specific	36
Data Use	
Used	55
Entered	28
Informal Entries (total no.)	62
Map Use	151
City	33
Standard	43
Oblique	49
Bus Routes	26
Map Choice	57
Standard	23
Oblique	34
Information Task	167
Accommodation	8
Attractions	71
Nitespots	28
Restaurants	55

Use Profile (cont'd) (number of uses)	
Transport	3
Travel Agencies	2
Location Task	58
Accommodation	6
Attractions	19
Nitespots	9
Restaurants	23
Transport	1
Travel Agencies	0
Type of Info Task	97
Name known exactly	4
Name not known	46
Word search	47
Type of Loc'n Task	17
Name known exactly	5
Name not known	5
Display category	7
Total Maps Used	151
Planimetric maps used	76
Procedural maps used	75

Table 9.11. Use Profile of Tourist Info.

• Attractions, Restaurants and Nitespots were the categories containing the most sought-after information from the database

• The same three categories featured most prominently on user-constructed map displays

• Most people approached the database not knowing the name of the facility they were looking for

• People often employed a keyword search through the database

• Few people chose to immediately display their chosen facility on a map. Instead, most people found the facility in the database and then displayed it on a map

• At first glance, the results suggest that information usage was preferred to location uses at a ratio of 3:1 (167 and 58 uses respectively). However, the system allowed users to display maps at any stage of their browsing. A better comparison is between the total number of information tasks chosen and the total map use (167 and 151 uses respectively).

Added to this summary of the statistics of system use are the comments made by the users. These comments fell into two categories: general thoughts about the system as a whole, and comments about the database and map components of the system. The comments are presented in this order.

Comments about Tourist Info

- "Possibly too confusing if you are not familiar with computers."
  (Male, under 20, Tourist, Literate)
- "A good idea, but too complex for tourists."
  (Male, over 60, Local, Illiterate)
- "Pretty good both for tourists and locals."
  (Female, 36-60, Local, Literate)
- "It's great - it would be good to get a more user-friendly low tech initial impact."
  (Female, 20-35, Local, Literate)
- "Excellent program, great graphics and a very friendly creator."
  (Male, 20-35, Tourist, Illiterate)
- "I think its an asset."
  (Male, 20-35, Tourist, Literate)
- "Good idea, helpful, useful."
  (Male, 20-35, Tourist, Illiterate)
- "Easy to use, incorporates good ideas."
  (Male, 20-35, Local, Literate)
- "A very good idea."
  (Female, under 20, Local, Illiterate)
- "Helpful, handy. It's hard to find a map of Christchurch with tourist stuff on it. This should be in the Square."
  (Female, under 20, Tourist, Literate)
- "Neat. Should be more people using it."
  (Male, under 20, Local, Literate)

Comments about system components

- "Interesting - preferred standard maps to oblique."
  (Male, 20-35, Tourist, Literate)

- "I used the oblique map because it looked nicer - cute, attractive and artistic." (Female, under 20, Local, Literate)
- "I wanted to look at the oblique map out of curiosity." (Female, 36-60, Local, Literate)
- "Excellent idea - just the right level of information." (Male, 20-35, Local, Literate)
- "This should be at the Information Centre or the Square so more can use it. It opens up the categories of what to do. You have much more freedom of expression than at the Information Centre. There, you're afraid to ask. The informal comments are useful in deciding what to do."
  (Female, 20-35, Tourist, Illiterate)

These comments were typed into the appropriate section of the program by nine males and seven females. Eleven were computer-literate, with only five 'illiterates' venturing an opinion. The people making these comments were generally younger than the sample average. The comments were generally positive about the concept and its implementation. The same sense of excitement engendered in geography students by the logarithmic transformation is in evidence here, with a number of people passing verbal comment on its appearance and usefulness.

A positive aspect of the testing was the extent which users took the chance to modify the contents of the program. They could do this in a number of ways. The easiest method was the ability to enter data in the informal database. 28 of the sessions involved the entering of informal data, with a total of 62 entries. Another way of modifying the program was the suggestion of a new facility (by two users) and a new category (one user suggested including coffee shops). These modifications are also easy to implement but were not followed up during the testing. No-one took the opportunity to suggest specific changes to the user interface, the types of maps or the conception of the project, though as recorded above two users suggested a simpler interface was needed.

Integrating the User and Use Profiles

This most important section of the results report looks to interpret the use profile with reference to the user profile. That is, an examination of the characteristics of the initiators of a particular logged use may help reveal why that particular use was made.

Type of Inquiry.

Two types of inquiry could be entertained by the system: a general browse, in which the user explored the system with no one stated aim; and a specific inquiry, a need which attracted the user to Tourist Info. The aggregated numbers suggest that users were evenly divided as to the type of inquiry made of the system. Breaking the figures down by gender, literacy and origin, however, gives a greater insight into the type of user attracted to Tourist Info.

Gender by Inquiry: (Table 9.12.). Males engaged in a much greater proportion of general browsing than did females. The author speculated on the reason for this: perhaps the female with a desire to browse the system did not have the confidence to approach the computer/operator, and a specific query gave her the necessary excuse; or, more likely, because men are more computer literate they are attracted to the system by a general curiosity not shared by most women.

X Gender	Inquiry Gen	sessions Spec	Ratio
Male	27	18	1.5 to 1
Female	7	18	0.4 to 1

Table 9.12. Gender by Inquiry cross-tabulation.

Literacy by Inquiry: (Table 9.13.). The computer-literate used general browsing as their preferred method of beginning a session on Tourist Info, while the computer-illiterate preferred a specific inquiry. The proportions are almost completely reversed. Both literacy and gender, therefore, may be the factor influencing the type of inquiry chosen by users - or another factor or set of factors, such as education, may influence literacy and gender alike. From the figures at hand, the only tentative statement that can be made is that, while literacy and gender have already been shown to be inter-related, literacy is likely to be a more plausible reason for choice of inquiry. Not only are the proportions greater, but the simple explanation can be offered that computer-literate people are much more likely to have the confidence and desire to browse the system, while the illiterate want to get the information they need and move on.

X Literacy	Inquiry Gen	sessions Spec	Ratio
Literate	23	14	1.6 to 1
Illiterate	11	22	0.5 to 1

Table 9.13. Literacy by Inquiry cross-tabulation.

This is important for the design of a UD-GIS. User-navigable pathways need to be provided to computer-illiterate users in order for them to quickly and easily gain their required information. The quicker and more easily such information can be obtained, the more likely such a user is to browse the system. Nine users of Tourist Info (or one in four) who began with a specific inquiry continued on to a general browse.

Origin by Inquiry: (Table 9.14.). It was expected that tourists would make specific inquiries, while locals, familiar with what Christchurch has to offer, would be more likely to browse. However, the proportions are remarkably similar. Origin is apparently not a factor in the mode of inquiry.

X Origin	Inquiry Gen	sessions Spec	Ratio
Tourist	13	14	1 to 1
Local	21	22	1 to 1

Table 9.14. Origin by Inquiry cross-tabulation.

Data Use.

55 of the 70 sessions saw some form of data use. Typically, this involved accessing the formal and/or informal databases for information about a particular facility (50 instances) or a group of facilities with something in common (47 instances) - for example, all motels with swimming pools. In addition, a pleasing aspect of the exercise was that, as mentioned, a significant number of users took the opportunity to enter their own data.

Neither the use nor the entry of data depended on computer literacy. In fact, no facet of the user profile seems to have unduly influenced the use or entry of data.

Map Use.

Four types of maps were offered, two planimetric and two procedural. Of these, the city map (planimetric) and the bus routes map (procedural) were default choices; that is, no other map type offered in the program could substitute for their coverage. The standard and oblique maps, however, overlapped in their coverage (Figure 9.29.). The system was programmed in such a way that any user request to display a facility that could be displayed by either map prompted a dialog box (see Figure 9.15.) requiring a user choice. This recording of map use was at the heart of the testing of map reconstitution.

Age by Map Use. (Table 9.15.) All ages used oblique maps at least as much as the planimetric alternative. In the case where users were forced to choose between maps, all ages preferred the oblique map to the standard map. The reasons offered for this choice were based on both effectiveness of the map and a desire to explore an alternative view of the city.

X	**Map Use** (total number)				**Map Choice**	
Age	City	Std	Obl	Bus	Std	Obl
<20	9	6	6	5	3	4
20-35	15	21	21	11	12	15
36-60	5	10	12	6	5	9
60+	4	6	10	4	3	6

Table 9.15. Age by Map Use cross-tabulation.

Gender by Map Use. (Table 9.16.) A significant difference is observed between the choices of maps made by men and those made by women. Almost as many men chose the standard map as chose the oblique map, but over twice as many women chose the oblique map over the standard map. A given female user is more likely to use the oblique map than her male counterpart.

X	**Map Use** (total number)				**Map Choice**		
Gender	City	Std	Obl	Bus	Std	Obl	Ratio
Male	16	28	32	17	17	20	0.9 to 1
Female	17	15	17	9	6	14	0.4 to 1

Table 9.16. Gender by Map Use cross-tabulation.

Literacy by Map Use. (Table 9.17.) The same pattern is repeated when computer literacy replaces gender as the variable. Once again, the inter-relationship of gender and literacy is noted. Computer-illiterate users preferred the oblique map a far higher percentage of the time than did literate users.

X	Map Use (total number)				Map Choice		
Literacy	City	Std	Obl	Bus	Std	Obl	Ratio
Literate	21	26	30	15	17	21	0.8 to 1
Illiterate	12	17	19	11	6	13	0.4 to 1

Table 9.17 Literacy by Map Use cross-tabulation.

Map Use by Origin. (Table 9.18.) A similar pattern is again in evidence when origin is considered. Tourists, whether male or female, literate or illiterate, marginally preferred the standard map when faced with a choice. As a number of them commented, it gave them a view of more of Christchurch. Because the oblique map was split into four discrete sections, users could not readily see a route between two locations. Locals, familiar with Christchurch's layout, preferred the oblique view over the standard map by a ratio of 7:3. The trend may well be fully explained by the inadequacy of oblique map coverage, but another explanation could be offered. The planimetric map might well be a better orientation tool, enabling people unfamiliar with an area to gain a quick 'overview', while to those already familiar with Christchurch, the oblique map is a more expressive way of representing an area.

X	Map Use (total number)				Map Choice		
Origin	City	Std	Obl	Bus	Std	Obl	Ratio
Tourist	13	21	17	7	14	13	1.1 to 1
Local	18	22	32	19	9	21	0.4 to 1

Table 9.18 Origin by Map Use cross-tabulation.

Interpretation of Results

Four significant aspects of the user profile (age, gender, origin and literacy) have been discussed with reference to three important components (type of inquiry, database use and map use) of Tourist Info. A summary of the results can now be offered.

- The users. The users of a UD-GIS are most likely to be young, computer-literate male locals from the dominant culture. However, a significant minority of non-literate users will be enticed into their first interactive spatial experience on a computer.
- The extent of use. This is hard to gauge. Only 68 actually used the system out of about 2500 to 3000 people who actually saw the machine during its test period. However, many of the people who passed the machine had no time or need to stop, were not allowed to do so (in the case of children and school parties) or were barred from using it because of language difficulties (foreign-language tourists). The potential user base may have been something closer to 1000, so the actual use may represent five to ten per cent of potential use. This is very much a speculative figure.
- The type of user reaction. Both recorded and verbal reaction was mostly positive, with some constructive criticism being offered. Particular mention was made of the oblique map, which was regarded as an interesting alternative to standard representation.
- Data of interest to users. Attractions, nitespots and restaurants were the most often used data. Travel Agencies were of no interest to tourists or locals, while only a few people made use of accommodation and transport information. This pattern reflects the overwhelming and unexpected use of the program by locals.
- Most used maps. The oblique map was favoured above all others, especially by females and the computer-illiterate. This pattern is confirmed by the data logger which recorded the results of user choices between the standard and oblique inner-city maps. Planimetric and procedural maps were used almost equally by users, even though the bus routes map was not available to youth hostel users.
- Amount and diversity of user input. A substantial amount of user input into the informal database was recorded. 28 users made 62 entries during the test. Sixteen users (about one in four) also took advantage of a facility which allowed them to make comments on the overall system and specific aspects of it.

• Required system modifications. It is the view of the author that the system needs modification. He shares the view of the user who suggested that the interface is still too confusing. Another necessary modification is the introduction of icon-driven, user-modifiable placement of facilities, so users can add to the maps and not just the database. Finally, and most importantly if the system is to be anything more than a shadow of a true GIS, a facility must be added with which to map the data itself (such as the 'good' restaurants) and not just the places by name or category.

• Ease of system modifications. Aspects of the formal and informal databases are easily modified, including the addition, subtraction or alteration of data. The addition of the Bus Routes map was made quickly after recommendations from Youth Hostel users, although it was not fully integrated into the system. Other aspects of the system, such as the interface and core routines, should not be directly user-modifiable (in order to prevent system crashes). They are able to be changed by the author in response to user suggestions.

• The number of iterations required to produce a satisfactory outcome. This last issue is not easily determined, as it depends on how satisfaction is defined. The program certainly satisfied its users, who commented on its wide range and unique ability to combine formal information and the particular usefulness of informal data from their peers. It satisfied the author in all aspects except the volume of usage.

This level of satisfaction has been achieved by five iterations: CustoMap, A Geographer's Guide to Dunedin, City Info, Tourist Info YHA and Tourist Info Museum. It could be suggested that if a program is not engendering a high level of user satisfaction after five iterations, the concept might be questionable.

As expected, possession of computer literacy was an important factor in enabling people to have access to the system. It is likely (but was not tested for, so cannot be proved) that the particular platform and software chosen for the project enlarged the population of potential users considerably. This is because of the easy-to-use, graphical interface of the Macintosh. More men than women used the system as a result of the distribution of computer literacy in society. For the same reason, fewer old people used the system than did young people (under 36 years of age). The way these people used the system was also influenced by computer literacy, with literates (and men) choosing to browse, as opposed to illiterates (and women) who used specific queries as their main mode of inquiry.

These comments are complicated by the problem of establishing the user profile of all those who visit the museum. As no records are kept of museum visitors, it is difficult to draw incontrovertible conclusions from the above analysis. It would be necessary to collect such records and note the biases in the sub-sample of museum visitors who used Tourist Info, then compare this with the nature of the potential audience for the system.

The inter-related factors of literacy and gender had most bearing on the type of map chosen in the task of user reconstitution. This is an unexpected result: the critical variable was expected to be *origin*. A pattern of map selection is identified in the cases where users were forced to make a recorded choice between the standard and oblique maps. Literate males tended to use standard maps much more frequently than illiterate females, who overwhelmingly chose the oblique map. The dominant group in western society, the educated male, has in this case reacted according to expectations, being more likely to choose a map projection characterised in this thesis as one of orthogonal imposition. The supposedly marginalised group of uneducated women has chosen the oblique map as an alternative means of expression, citing factors such as aesthetics instead of utilitarian values. The oblique map shows signs of fulfilling its alternative reconstitutive role, allowing people much more freedom of self-expression. It is both significant and gratifying that the oblique map should have been chosen by so many women unfamiliar with computer technology.

This self-expressive nature of the oblique map is verified by the reluctance of tourists to use it. Tourists favoured the standard map as their reconstitutive vehicle for pragmatic reasons, having a much greater need for precise orientation, location and navigation information. it is also likely that many tourists have gained experience in using planimetric maps on their travels. Many more locals, on the other hand, chose the oblique map as an alternative means of reconstituting the city they already knew.

Conclusion

The last section of the chapter considers these results in the broader context of the concept of a User-Driven Geographic Information System. The example of a user-driven Geographic Information System developed for this thesis has not proved to be totally effective in capturing the interest of the computer-illiterate. While such a system may be very effective in offering well-received and useful alternative reconstitutions and deconstitutions, the major barrier to interactive mapping is the medium, not the message.

This idea of user access to maps and the medium in which they are rendered is crucial. By using a computer screen rather than a sheet of paper, the researcher may simply be marginalising another group of users: older, computer-illiterate people who could read an atlas very well may not be able to use the computer equivalent. While programs like Tourist Info expose previously marginalised groups to alternative reconstitutions and provide people with an opportunity to deconstitute their own data, they are not the complete answer to the provision of alternative cartographic formulations. They may, however, be excellent complements to existing cartographic systems, widening the audience for spatial information.

This exercise helps to substantiate the discussion about alternative types of cartographic form and content introduced in Chapters Seven and Eight. It was suggested in Chapter Seven that an oblique procedural map might be more meaningful to users with real-world problems than a planimetric map, and this was confirmed by the results of Tourist Info map use. Discussion in Chapter Eight centered around the concept of users deconstituting data relevant to their needs, and Tourist Info was used for this purpose.

In terms of the MUGs analysis offered in Chapter Three, Tourist Info has shown the potential of UD-GIS's to place the shaping and control of information in the hands of those who need it. That is, users rather than generators determine what is important to be mapped and how it should be mapped. The generator is reduced to a provider, and the level of effective generator control is greatly reduced. This has far wider implications than cartography, for society is becoming more dependent on the provision of all types of information, and those who control people's access to such information are able to exercise power in our society. This issue is raised in the next and final chapter.

Above all, however, such systems are useful to people in the real world. Despite the reservations outlined above, Tourist Info is judged by the present author to be a promising beginning to the task of introducing alternative cartographic deconstitutions and reconstitutions. It has shown that a fully-featured UD-GIS is at least possible. Recommendations for further development in this area are offered in the concluding chapter of this thesis.

UD-GIS's are also a commodity with commercial potential, a point brought home to the author when a representative of the Christchurch

International Airport Company offered to purchase the system, as it was, for use in its information centre. It may not be long before map generators introduce similar systems with less user flexibility as another method of imposition and control. This suggests an examination of the ethics, sponsorship and administration of such systems need to be addressed, an issue touched on in the following final chapter.

Chapter Ten
Conclusion

This concluding chapter is written to fulfil three objectives: to summarise the argument of this thesis; to highlight the major contributions of this work to cartographic and geographic thought; and to suggest areas worthy of further inquiry.

Summary of the argument

This thesis has pursued the basic argument that people have difficulty using maps because they are not invited to participate in the mapping experience. Putting Self on the Map has been an attempt to establish this argument (Parts 1-3) and to explore methods for obviating some of those difficulties (Part 4).

We are in a position to outline how each of the three thesis goals, as defined in Chapter One, page 6, have been met.

1). To investigate possible causes of difficulties in map interpretation.
The presupposition upon which the research was based is that people conduct communicative activity as a form of ritual designed to advantage some participants over others (Chapter Two). The mechanics of this interaction ritual as applied to cartographic communication were summarised by the MUGs model (Chapter Three) in which the role of the map generator is given prominence. How meaning is recovered from such interactions was the subject of Chapter Four, in which it was argued that 'relevance' is the goal of those participating in cartographic communication.

The first four chapters pointed to possible sources of interpretative difficulty for map users, summarised (pp. 82-83) as:

- Insufficient mutual manifestness.
- Lack of iteration.
- The 'eavesdropping' effect.
- Lack of relevance.
- Unequal power relations.
- Informational barriers.
- Message and need conflict.

These seven difficulties have been explicitly related to the social context in which maps are generated, made and used.

2). To provide historical and contemporary explanations of difficulties in map interpretation.

Part Three of this thesis was a historical and contemporary review of cartography, conducted to establish whether the theoretical difficulties identified in Parts One and Two actually existed in the real world. Chapter Five demonstrated the effect that an impositional map geometry has had on cartographic history, while Chapter Six showed that an emphasis on subject matter requiring a high degree of positional map accuracy has made maps less accessible to many users. Statements 6.1, 6.2 and 6.3 (pp. 147-149) are a summary of the manifestations of map form and subject matter in contemporary society.

3). To postulate, examine and test alternative cartographic formulations designed to ease difficulties in map interpretation.

Part Four of this thesis examined alternative reconstitutions of map form (Chapter Seven) and alternative deconstitutions of map content (Chapter Eight). A procedural map form and the user-driven generation of subject matter were concluded to be alternatives which would alienate fewer map users, thereby promoting better map interpretation. These ideas were combined for testing in the construction and operation of a User-Driven Geographic Information System (Chapter Nine). Tourist Info has demonstrated that a number of map users favour the oblique procedural map form over the traditional planimetric map. The results also indicate a high level of participation in deconstitutive activity.

The Contribution of this Thesis

This thesis is based on ten important concepts. Nine of these are new to cartographic writing, being either of the author's own conception or a significant advancement of an idea first expressed elsewhere. The tenth has become established in recent years among critical writers. These ten concepts are found in Chapters Two through Nine, as follows:

Chapter Two

1). The role of the self is central in the relationship between human agency and social structure underlying the generation, production and use of maps.

Chapter Three

2). Map generators are identified as the initiators of the mapping process, exercising a large degree of influence on map form and content.

3). An original view of the mechanics of cartographic communication, including the role of the map generator, is summarised as the MUGs model.

Chapter Four

4). Elements of Relevance theory, a psycholinguistic theory of communication, are used to construct an original account of how meaning is transferred during cartographic communication.

Chapter Five

5). A crucial development in the history of cartography is identified as the transition in geometry from the circular to the orthogonal. The orthogonal grid is a more impositional map form than is its predecessor.

Chapter Six

6) Map content tends to be impositional in nature. This concept has been articulated by a growing number of writers.

7). The emphasis on positional accuracy in maps is driven by exploitative generator needs and is a barrier to many potential map users.

Chapter Seven

8). An alternative to the orthogonal map form is to adopt a procedural perspective whenever scale and subject matter permit.

Chapter Eight

9). An alternative to impositional cartography is to put self back on the map, allowing users to be involved in deconstitution and reconstitution.

Chapter Nine

10). A User-Driven Geographic Information System allowing alternative deconstitution and reconstitution was postulated, designed and tested.

Future Directions

Areas for Further Research

This thesis is not only *about* communication; it *is* communication. As such, it is open to the same type of criticism as it has raised against the map. However, unlike most maps, this thesis does not pretend to be a definitive statement of the way things really are. Rather, it maps the evolution of the present author's thinking over a four-year period. Taking the analogy a stage further, this thesis is more like the UD-GIS developed in Chapter Nine, an indicative rather than complete effort. There are many areas of inquiry arising from this work that are worth pursuing.

1). *Proof of user difficulty with traditional cartography.*

The argument in Part One of this thesis asserted rather than demonstrated the argument that many map users have difficulty interpreting traditional cartography. This was not empirically assessed, anecdotal evidence being used instead. The demonstration of this argument may be a thesis in itself, entailing an assessment of the large number of empirical studies which examine user performance and comparing these with comments from the users themselves. A necessary added dimension would be the discovery of reasons why non-users chose not to use maps for spatial tasks.

2). *Cartographic communications theory.*

Part Two of the thesis offers a significant advance in cartographic communication theory. The MUGs model has a degree of explanatory power, as evidenced by the Fendalton road-widening example presented on pages 126-131. The application of Relevance theory to cartographic communication provides a greater degree of understanding of how meaning is transferred and evoked. Both the MUGs model and Relevance theory require further research of a level of detail not possible in this thesis.

Firstly, a wide range of historical and contemporary examples of maps could be assessed using the MUGs model. This would involve finding out the identity of the map generator, the reasons for the production of each example, and the use to which they were put. Such an exercise would help to refine the model.

Secondly, Relevance theory needs to be applied to specific communicative situations. The discovery of the extent to which contexts are shared by generators and users, and the degree to which the effort-effect equation of relevance applies in real-world situations, would enable the researcher to tailor the theory to cartography.

Thirdly, it is suspected that Relevance theory and the MUGs model could be combined into a powerful analytical tool. For example, both the MUGs model and Relevance theory identify ways in which impositions can be made upon map users, and both identify the source of those impositions as the generator of communication. While this thesis has dealt separately with the mechanics of communication (MUGs model) and the meaning of communication (relevance), there may be some way to combine them without committing the errors inherent in the Process and Semiotic models of communication (Chapter Three).

3). *Information Theory.*

It can readily be seen that issues relating to the provision of cartographic information are similar in nature to information issues in general. Mapped information is one form of information organisation and display particularly suited to spatial tasks. Problems of interaction, control, manipulation and imposition are likely to exist in the provision of all forms of information. It may be, therefore, that some of the general principles uncovered in this thesis are applicable to areas other than cartography. Work that attempts to link this study with general and specific problems of communication and information provision is likely to be profitable.

4). *The Social and Cultural context of Perspective.*

This thesis has demonstrated a number of important principles which may guide future reconstitutive mapping activity. A case has been made for the interlinkage of spatial and cultural perspective, arguing that the way people view their world influences and is influenced by their social context. The present author is keen to explore this linkage more closely, seeking to examine the relationship between geometry, perspective and culture.

5). *The type of subject matter of relevance to map users.*

One of the most difficult, and least satisfactorily answered, aspects of this thesis is how one might discover the topics that map users want maps to address. <u>Tourist Info</u> allowed map users to suggest topics, but this facility was not taken advantage of. Research into the types of spatial data most used by people may yield a number of topics which at present are not mapped. An example of this was the Campus Fear map discussed in Chapter Seven. Maps such as this could be incorporated into a G.I.S.

6). *The Development of UD-GIS.*

The testing of Tourist Info foreshadows the application of alternative mapping principles to UD-GIS's which can interactively display their cartographic product to the satisfaction of the map user.

Tourist Info, however, was hampered by a number of design limitations, mostly of a technological nature. Neither the hardware nor the software were ideal for the task, and other existing platforms (such as Sun workstations or Archimedes microcomputers) and programming environments will, while demanding more initial setting up, provide a system with a greater number of features.

One of the dangers of a commitment to technology is that research is prone to become technology-driven. In order to remove that tendency, the present author speculates about the benefit a UD-GIS might provide if present technological limits are ignored.

The Ideal UD-GIS

Figure 10.1 is a re-drawing of Figure 8.3, with three specific features added. The implementation of these features were not possible using Tourist Info, and are discussed below. They fall into two categories: features to manage the flow of information, and system improvements designed to accommodate these flows of information.

1). Information management.

Firstly, any UD-GIS designed for community use should be administered by that community. A system such as Tourist Info should be administered by representatives of tourist interests, not tourism interests. The difference is subtle but crucial, as the present author's experience with the Canterbury Promotion Council testifies (Chapter Nine). The community administration might take the form of elected office or committee. The responsibility of this committee would be to ensure the regular editing and updating of information. This would include the provision of information to users and the gathering of informal information from those users.

Secondly, UD-GIS's can serve far broader communities than one specific interest group, as was the case with Tourist Info. Retail information, for example, could usefully be made available to everyone in an area. The broader the categories of data included in any one system, the more productive the resulting maps can become. It might be possible, for example, to plan one's shopping before one leaves home, including finding the least busy route to the shopping centre, reserving a parking space, identifying the shops with the required items and somewhere to eat lunch. One map could be printed out which summarised this information.

2). System improvements.

A third feature shown on Figure 10.1 is the size of the system. A UD-GIS should ideally be portable and widely available, perhaps linked to a comprehensive, pocket-sized information unit. Screen size could be as small as the shaded area in Figure 10.1, with a high resolution. Portability is essential because maps are constantly referred to, and are of less use if limited to a few locations. The same can be said of a UD-GIS. Portability removes a major barrier to user access, and also diminishes the prospect of a few corporate vendors gaining control of the system. The technology to achieve this will in all likelihood be available soon after the supply of superconductors in commercial quantities.

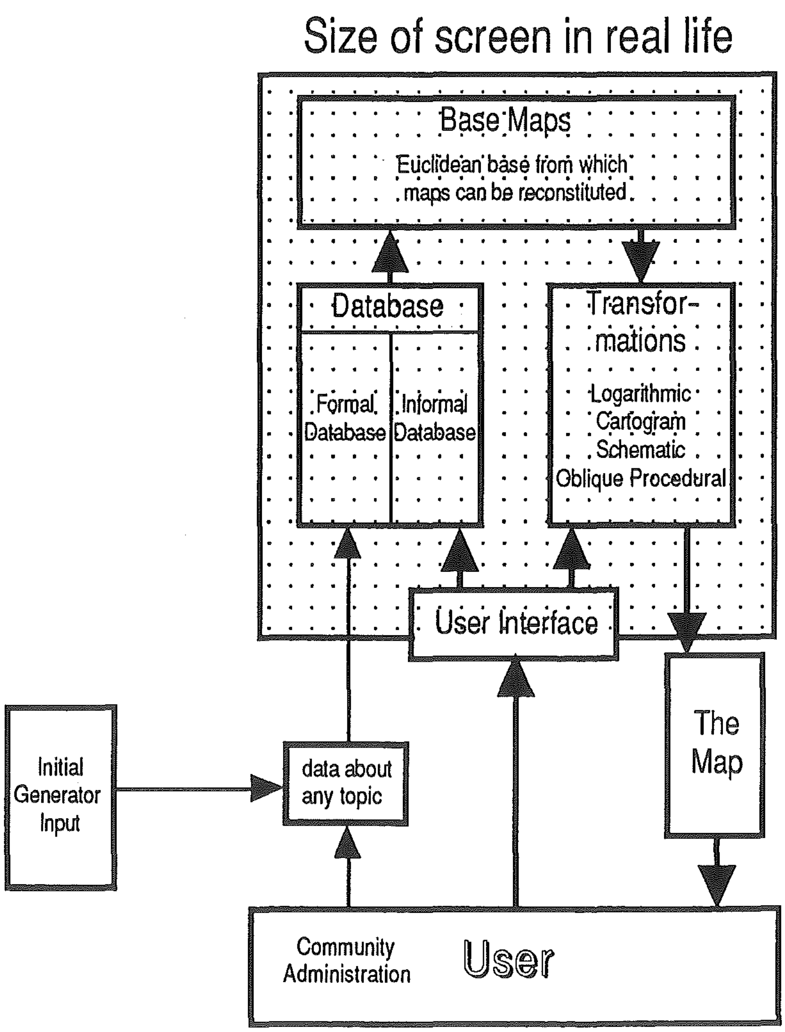


Figure 10.1. The ideal UD-GIS.

Figure 10.1 confirms the degree to which a UD-GIS helps to reduce the dominance of map generators. When compared to the MUGs model (Figure 3.10), the ideal UD-GIS shows how the map user might subsume the roles of deconstituter and reconstituter (the map maker), and gradually take over the role of the map generator (apart from an initial input). Because the user generates and makes the map, he or she is a targeted user, which minimises the 'eavesdropping' effect. Eventually the system may become self-perpetuating, with the community of users generating, making and using the product. There need be no involvement by anyone not using the system.

The everyday use of UD-GIS by a wide range of people may require a progression such as is outlined in the following three steps.

1). Individual system are made available to information centres, such as city councils, hotels, tourist attractions and airports. The information collected at each system is collected and collated on a regular basis, with updates being sent to each system operator on disk.

2). The software is ported to other platforms, making it available to all home computer users (the number of whom is likely to be greater in the future). These computers can be connected by modem to a central editing and collating service, which will update all systems with the information entered into each system.

3). Finally, when technology allows, systems will become portable and communication will not require cabling. This will allow spatial queries to be answered 'on the spot' rather than at home or at a central location.

No matter how sophisticated a system becomes, and no matter how responsive it is to the needs of users, some form of administration and management will be required. This need raises the risk of excessive generator control. In the author's opinion, this risk will always be present. The self-centered nature of human activity (Chapter Two) leads one to expect that some people will attempt to use a community database to advantage themselves over others. In the end it is people, not their tools, that may require the most changing.

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Appendix 1

Routines

Subroutines in SuperTalk, the programming language of SuperCard, are known as scripts. Scripts are stored in discrete chunks and activated separately by 'events' such as a mouse click. Two of the most commonly used routines in the program (see Chapter Nine) are shown below in the smaller text, divided into their separate but dependent scripts, with comments appended to them. These comments are separated from the scripts by a double hyphen (--) and are italicised.

A. Find Location

1). choose whether to find information about or location of the facility;

```
on mouseUp
	play "click"	-- This, and all clicks to follow, is a sound played to let the user know the button has been activated.
	visual scroll left
	go to cd "Loc"
end mouseUp
```

2). indicate whether or not the name is known exactly;

```
on mouseUp
	play "click"
	add 1 to cd field "Two" of cd "Counter" of wd "Dummy" of project "Tourist Info" --  This records the user choice in the program's data logger.
	add 1 to cd field "Total Location Task" of cd "Counter" of wd "Dummy" of project "Tourist Info"
	add 1 to cd field "Task Total" of cd "Counter" of wd "Dummy" of project "Tourist Info"
	close wd "Help"
	open cd "Lists2" of wd "Lists"
	close wd "Introduction"
end mouseUp
```

3). choose which category (of six) the facility belongs to;

```
on mouseUp
	global Location_Btn
	play "Click"
	put "True" into Location_Btn
	open cd "Accommodation2" of wd "Scrolling List"
end mouseUp
```

4). select the name of the facility from a category list.

```
on mouseUp
	global card_temp, Location_Btn
	play "Click"
	put "True" into Location_Btn
	close wd "Help"
	close wd "Lists"
```

```
put the hilitedLines of cd field "List" into card_temp
set rect of wd "Info" to 490,10,640,85
open cd card_temp of wd "Info"
get Location_Btn
if Location_Btn is "False" then            -- a graceful "out" if the program can't find the card selected on any
map.
    play "HAL"                             -- a sound from "2001: A Space Odyssey".
    answer "I'm sorry, I'm afraid I can't do that." with "Why Not?" or "OK"
        if it is "OK" then
            close wd "Info"
            close wd "Control Panel"
            show menuBar
            open cd "Loc" of wd "Help"
            exit mouseUp
        else
        if it is "Why Not?" then
            open cd "Why Not?" of wd "Project Help"     -- this window tells the user why the facility
can't be shown.
                exit mouseUp
            end if                              – the end of the "out"
        end if
    else
      send mouseUp to cd btn "Location" of cd card_temp of wd "Info"    -- activates the following subroutine
end if
end mouseUp
```

This subroutine sets the correct variables for the following routine based on the particular card's unique attributes.

```
on mouseUp
  global field_temp, card_temp, button_temp, var1, var2, var3, var4
  location_script
  put bg field "card title" of window "Info" into button_temp
  put bg field "List category" of wd "Info" into field_temp
  put "2" into var1            -- 1st unique attribute
  put "Two" into var2          -- 2nd unique attribute
  put "80,180" into var4       -- 3rd unique attribute
  findMe                       -- activates the "findMe" subroutine
end mouseUp
```

This "findMe" subroutine locates and highlights a facility chosen by the "Location" button on the "Info" window.

```
on findMe  --this script locates the place corresponding to the Info card name on one of three map types.
  global window_temp, button_temp, field_temp, var1, var2, var3, var4, open_map, choice

  if var1 = 1 then
    close wd "Oblique"
    close wd "Oblique Instructions"
    close wd "Standard"
    set rect of wd "Info" to 490,10,640,25
    open cd var2 of wd "City"
    show cd field "Instructions" of cd var2 of wd "City"
    set cursor to 1
    set the lockText of cd field "Instructions"  of cd var2 of wd "City" to false
    put empty into cd field "Instructions" of cd var2 of wd "City"
    click at the loc of cd field "Instructions" of cd var2 of wd "City"
    type "Click anywhere on the map to stop the button flashing.  "
    set the lockText of cd field "Instructions"  of cd var2 of wd "City" to true
    repeat forever
        set visible of cd graphic button_temp to not the visible of cd graphic button_temp       -- flashes the
facility on and off until the user clicks the mouse.
```

```
            wait 5
              if the mouse is down then exit repeat
          end repeat
          set visible of cd graphic button_temp to true
          hide cd field "Instructions" of cd var2 of wd "City"
      else
          if var2 = "City Standard" then
              hide menuBar
              close wd "Oblique"
              close wd "Oblique Instructions"
              close wd "City"
              set rect of wd "Info" to 490,10,640,25
              set rect of window "Standard" to 0,38,640,480
              open wd "Standard"
              set the scroll of window "Standard" to var4    --the loc of btn button_temp
              open wd "Standard Instructions"
              open wd "Standard"
              repeat forever
                  set visible of btn button_temp to not the visible of btn button_temp          -- flashes the
facility on and off until the user clicks the mouse.
                  wait 5
                    if the mouse is down then exit repeat
              end repeat
              set visible of btn button_temp to true
              close wd "Standard Instructions"
          else
              play "Hey"
                open wd "Map Choice Dialog"   -- activated if the facility is in the central city, leading to routine 5
below.
                put "FindMe" into choice    -- lets routine 5 know that a particular facility is sought rather than just
opening the map.
          end if

          -- This part of the subroutine records the user choice in the program's data logger.

          if field_temp = "Accommodation" then  -- add 1 to contents of PhD counter
              add 1 to cd field "Accommodation Location" of cd "Counter" of wd "Dummy" of project "Tourist Info"
              add 1 to cd field "LocationTotal" of cd "Counter" of wd "Dummy" of project "Tourist Info"
          else if field_temp = "Attractions" then
              add 1 to cd field "Attractions Location" of cd "Counter" of wd "Dummy" of project "Tourist Info"
              add 1 to cd field "LocationTotal" of cd "Counter" of wd "Dummy" of project "Tourist Info"
          else if field_temp = "Nitespots" then
              add 1 to cd field "Nitespots Location" of cd "Counter" of wd "Dummy" of project "Tourist Info"
              add 1 to cd field "LocationTotal" of cd "Counter" of wd "Dummy" of project "Tourist Info"
          else if field_temp = "Restaurants" then
              add 1 to cd field "Restaurants Location" of cd "Counter" of wd "Dummy" of project "Tourist Info"
              add 1 to cd field "LocationTotal" of cd "Counter" of wd "Dummy" of project "Tourist Info"
          else if field_temp = "Transport" then
              add 1 to cd field "Transport Location" of cd "Counter" of wd "Dummy" of project "Tourist Info"
              add 1 to cd field "LocationTotal" of cd "Counter" of wd "Dummy" of project "Tourist Info"
          else if field_temp = "Travel Agencies" then
              add 1 to cd field "Travel Agencies Location" of cd "Counter" of wd "Dummy" of project "Tourist Info"
              add 1 to cd field "LocationTotal" of cd "Counter" of wd "Dummy" of project "Tourist Info"
          end if
      end if
      unlock screen
end  findMe
```

If the Standard map is chosen, the following routine is activated:

```
on mouseUp
     global var4, button_temp, choice
     play "click"
```

```
        lock screen
        get choice
        if it is "FindMe" then                    -- this subroutine is activated when a particular facility is sought.
                close wd "Map Choice Dialog"
                open cd "Counter" of wd "Dummy"              -- the user choice is recorded in the data logger.
                add 1 to cd field "Standard Choice" of cd "Counter" of wd "Dummy" of project "Tourist Info"
                add 1 to cd field "Total Choice" of cd "Counter" of wd "Dummy" of project "Tourist Info"
                open cd "Personal Counter" of wd "Dummy"
                add 1 to cd field "Standard Choice" of cd "Personal Counter" of wd "Dummy" of project "Tourist Info"
                add 1 to cd field "Total Choice" of cd "Personal Counter" of wd "Dummy" of project "Tourist Info"
                hide menuBar
                close wd "Oblique"
                close wd "Oblique Instructions"
                close wd "City"
                set rect of wd "Info" to 490,10,640,25
                open wd "Standard"
                set rect of window "Standard" to 0,38,640,480
                set the scroll of window "Standard" to var4          --the loc of btn button_temp
                open wd "Standard Instructions"
                open wd "Standard"
                repeat forever
                        set visible of btn button_temp to not the visible of btn button_temp          -- flashes the facility
on and off until the user clicks the mouse.
                        wait 5
                        if the mouse is down then exit repeat
                end repeat
                set visible of btn button_temp to true
                close wd "Standard Instructions"
        else
                if it is "CityCentre" then                    -- this subroutine is used only when the user is browsing.
                        close wd "Map Choice Dialog"
                        open cd "Counter" of wd "Dummy"              -- the user choice is recorded in the data logger.
                        add 1 to cd field "Standard Choice" of cd "Counter" of wd "Dummy" of project "Tourist Info"
                        add 1 to cd field "Total Choice" of cd "Counter" of wd "Dummy" of project "Tourist Info"
                        open cd "Personal Counter" of wd "Dummy"
                        add 1 to cd field "Standard Choice" of cd "Personal Counter" of wd "Dummy" of project "Tourist
Info"
                        add 1 to cd field "Total Choice" of cd "Personal Counter" of wd "Dummy" of project "Tourist Info"
                        open wd "Standard"
                        close wd "City"
                end if
        end if
end mouseUp
```

If the Oblique map is chosen, the following routine is activated:

```
on mouseUp
        global var2, button_temp, choice
        play "click"
        lock screen
        get choice
        if it is "FindMe" then
                close wd "Map Choice Dialog"
                open cd "Counter" of wd "Dummy"
                add 1 to cd field "Oblique Choice" of cd "Counter" of wd "Dummy" of project "Tourist Info"
                add 1 to cd field "Total Choice" of cd "Counter" of wd "Dummy" of project "Tourist Info"
                open cd "Personal Counter" of wd "Dummy"
                add 1 to cd field "Oblique Choice" of cd "Personal Counter" of wd "Dummy" of project "Tourist Info"
                add 1 to cd field "Total Choice" of cd "Personal Counter" of wd "Dummy" of project "Tourist Info"
                if var2 = "City Standard" then
                        play "HAL"
                        answer "I'm sorry, I'm afraid I can't do that." with "Oh well"
                        close wd "Oblique"
                        close wd "Oblique Instructions"
```

```
        else
            hide menuBar
            close wd "Standard"
            close wd "City"
            close wd "Browse"
            set rect of wd "Info" to 490,10,640,25
            open cd var2 of wd "Oblique"
            show cd field "Instructions" of cd var2 of wd "Oblique"
            set cursor to 1
            set the lockText of cd field "Instructions"  of cd var2 of wd "Oblique" to false
            put empty into cd field "Instructions" of cd var2 of wd "Oblique"
            click at the loc of cd field "Instructions" of cd var2 of wd "Oblique"
            type "Click anywhere on the map to stop the button flashing.  "
            set the lockText of cd field "Instructions"  of cd var2 of wd "Oblique" to true
            repeat forever
                set visible of cd graphic button_temp to not the visible of cd graphic button_temp
                wait 5
                if the mouse is down then exit repeat
            end repeat
            set visible of cd graphic button_temp to true
            hide cd field "Instructions" of cd var2 of wd "Oblique"
        end if
        unlock screen
    else
        if it is "CityCentre" then
            close wd "Map Choice Dialog"
            open cd "Counter" of wd "Dummy"
            add 1 to cd field "Oblique Choice" of cd "Counter" of wd "Dummy" of project "Tourist Info"
            add 1 to cd field "Total Choice" of cd "Counter" of wd "Dummy" of project "Tourist Info"
            open cd "Personal Counter" of wd "Dummy"
            add 1 to cd field "Oblique Choice" of cd "Personal Counter" of wd "Dummy" of project "Tourist
Info"
            add 1 to cd field "Total Choice" of cd "Personal Counter" of wd "Dummy" of project "Tourist Info"
            open wd "Oblique"
            close wd "City"
        end if
    end if
end mouseUp
```

B. Enter Data.

1). choose whether to find information about or location of the facility;

```
on mouseUp
    play "click"    -- This, and all clicks to follow, is a sound played to let the user know the button has been
activated.
    visual scroll left
    go to cd "Info"
end mouseUp
```

2). indicate whether or not the name is known exactly;

```
on mouseUp
    play "click"
    global card_temp
    add 1 to cd field "Five" of cd "Counter" of wd "Dummy" of project "Tourist Info"   -- the user choice is recorded
the data logger.
    add 1 to cd field "Total Info Task" of cd "Counter" of wd "Dummy" of project "Tourist Info"
    add 1 to cd field "Task Total" of cd "Counter" of wd "Dummy" of project "Tourist Info"
    ask "Type the EXACT name of the place."   -- displays a dialog box asking the user to type the name of the
facility.
```

3). type the name of the facility into the program;

```
    if it is empty then
        exit mouseUp        -- if the user does not type a name, the routine quits gracefully.
    else
        if it is not empty then
            put it into card_temp
            close wd "Help"
            close wd "Introduction"
            hide menuBar
            open cd "A & A Motel" of wd "Info"
            get bg field "Card Title" of bg "Info" of wd "Info"
            find card_temp in bg field "Card Title"        -- finds the correct info card in the info window.
            if the result is not empty then
                play "Beeep"                   -- alerts the user to a problem.
                open last card of wd "Advice"  -- provides the user with help if the name can't be found.
                exit mouseUp
            end if
        end if
    end if
end mouseUp
```

4). type data into the comments space provided.

Appendix 2

Tourist Info Disks and Instructions

SYSTEM REQUIREMENTS

The thesis version of Tourist Info has been constructed to run on a Macintosh LC, II, IIx, IIcx, IIci or IIfx with a standard 13″ Apple Hi-Res colour monitor. You will need at least 2 megabytes of RAM (preferably 4) to run the program. Finally, you will need to install Tourist Info on a hard disk.

• In summary, the minimum requirements are:
Macintosh LC with hard disk, 13″ colour monitor and 2 megs of RAM.

GETTING Tourist Info UP AND RUNNING

Tourist Info is located in a pocket on the inside back cover of this thesis. You will notice that at present the program has been split into two separate disks (labeled 'Tourist Info 1' and 'Tourist Info 2'). In order to use the program, follow these instructions:

1). Copy *all* the contents of both floppy disks on to your hard disk.

2). Eject both floppy disks.

3). Open StuffIt by double-clicking on its icon.

4). Select "Join" from the "Options" menu.

5). You will be asked to select the first segment to join and, naturally enough, you should select "Tourist Info.seg1."

6). When requested, choose "Tourist Info.seg2" in the same way.

7). Ensure that the joined program is named Tourist Info. *It must have this name in order to work.*

8). You can now quit from Stuffit.

Tourist Info is now ready to run. Just double-click on the Tourist Info icon. After a few seconds the "Introduction" window is displayed. Follow the on-screen instructions to use the program.